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EVERYTHING PNEUMATIC.

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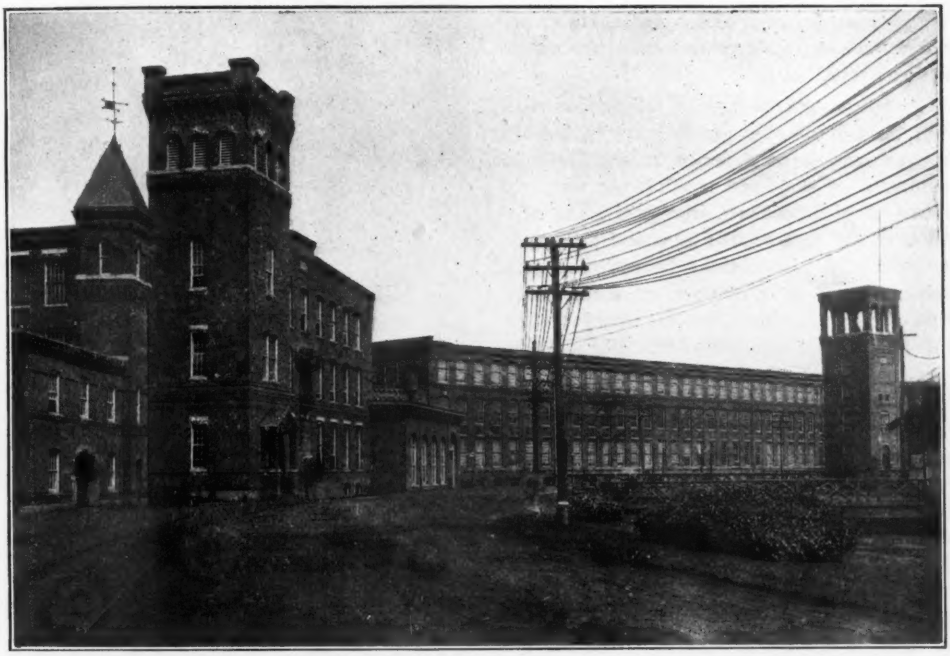

FIG. I. A TYPICAL COTTON MANUFACTURING PLANT. MILL OF THE CHICOPEE MFG. CO., CHICOPEE FALLS, MASS.

COMPRESSED AIR IN THE COTTON INDUSTRY

BY C. C. PHELPS.

From the moment that the raw cotton is picked until the bolts of fabricated goods are ready to leave the factory, air, in various degrees of compression or expansion, plays an important part in assisting in the various stages of manufacture.

REMOVING THE COTTON SEEDS.

The ripe cotton bursts from its boll or containing capsule and is then picked by hand. The cotton, as it is picked, consists of a woolly, fibrous material in which the individual fibres vary in length up to two inches (depending upon the kind of cotton, locality, etc.) and a large number of seeds embedded in the fibrous material. The first process encountered is the removal of these seeds and any large particles of foreign matter. The cotton gin is universally used for this purpose. In the days when Eli Whitney gave to the world the cotton gin, the cotton-seed was regarded as the curse of the cotton grower. The

troublesome seeds were removed in a thoroughly satisfactory manner by Whitney's gin and were cast aside as useless. Modern science, however, has found a multitude of uses for the formerly despised cotton-seed and now it is looked upon with considerably more respect.

The pure food agitators tell us that we eat it in the form of butter, olive oil, pork products, etc. However we are not in a position to affirm or deny the truth of these statements. We do know, however, that compressed air plays an important part in preparing cotton-seed oil for the market, for instance for operating formers, and for cleaning crusher rolls and separator plates,—however that is another story.

The cotton gin of to-day differs but little from the gin of Whitney's time. In outline, the gin consists of a series of circular saws mounted on a shaft and revolving between the interstices of an inclined iron grid. The seed cotton is fed at a regular rate and falls upon the grid. The saw blades beneath the grid, probably 60 or 70 in number, draw the cotton fibres through the grid, leaving the seeds behind. The seeds slide off of the grid and into a bin.

A revolving brush removes the fibres from the saw blades, whereupon they are carried by a strong blast of air through a flue and deposited upon a perforated roller. Suction is maintained on the system through an exhauster connected with the interior of this perforated roller, so the cotton is drawn to and adheres to the roller until it reaches an opening in the casing of the machine, when the strip of lint cotton emerges from the gin and is piled on the floor.

BALING THE COTTON.

After leaving the gin, the cotton is sometimes rolled into cylindrical bales, but is more usually packed into rectangular bales that vary in weight in different places from under 200 to over 700 pounds. Some form of power baler is necessary, as cotton is naturally very bulky for its weight, and it must be packed into as small a space as practicable. Three forms of presses are commonly used for this purpose, namely, steam, hydraulic and pneumatic. The baled cotton is then covered with jute bagging and secured by iron bands.

TRANSPORTATION OF COTTON.

The baled cotton is handled in different ways at the various shipping ports and transportation centres. Compressed air locomotives have been used to a certain extent for hauling cars of baled cotton. They are ideal for this purpose as the danger from sparks, which is ever present with steam and electric locomotives is entirely eliminated with the compressed air locomotive. Of course, air hoists

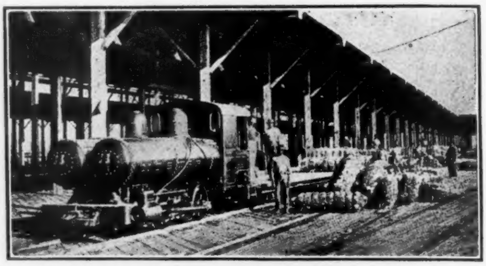

FIG. 2. A COMPRESSED AIR LOCOMOTIVE USED FOR TRANSPORTING BALED COTTON.

and lifts are also suitable for handling the individual bales.

FIRE RISK.

A cotton fire is one of the most difficult to extinguish, because the flame, once started in a bale of cotton, will continue to burn in spite of drenchings with water. The cotton is so closely compacted that the water has little opportunity to enter the interior of the bale and the fluffy nature of the cotton allows a large relative volume of air to surround the cotton fibres thus assisting combustion. The lint and cotton dust which are bound to collect where cotton is handled furnish ideal conditions for the starting of a fire. From the above, it can be readily seen that exceptional precautions must always be taken against the fire risk where cotton is handled. The history of fire fighting tells us that many of the most stubborn fires have occurred in cotton mills and warehouses.

COTTON MANUFACTURE.

We will now consider the various manufacturing processes. Generally speaking, there are three stages in the process of manufacture: (1) Spinning, (2) weaving or knitting, and (3) finishing. The first two processes are often carried out in the same mill, but

finishing differs very radically from the other processes, being largely of a chemical and physical nature, whereas the spinning and weaving are mainly mechanical operations. In following this outline of the various processes involved, it must be borne in mind that many of the steps described are omitted in certain cases, depending upon the results desired. Likewise, some of the steps may be repeated to secure further refinements or modifications may be substituted to obtain particular results.

The mill treatment comprises (1) mixing the raw cotton from several bales into a homogeneous mass, (2) removing particles of foreign matter from the cotton, (3) combing out entanglements in the fibre and arranging the fibres in parallel lines, (4) combining groups of parallel fibres, simultaneously attenuating same, (5) twisting the fibres into a thread, (6) compounding and making-up of threads, (7) weaving or knitting, and (8) various finishing processes.

SPINNING AND PRELIMINARY PROCESSES.

After the bale has been stripped by hand it enters a bale breaker whose function it is to disentangle the fibres that have been converted into hard masses, and mix the cotton. Mechanical bale breakers are of several types. Roller breakers consist of spiked rollers which reduce the stock to a fluffy mass, after which a fluted roller delivers it upon a traveling lattice which carries it to the floor of the mixing room. Hopper breakers consist of a horizontal traveling lattice which conveys the cotton and a sloping spiked one whose spikes tear away tufts of cotton and deposit them upon a second lattice for removal to the mixing room. A good mixing is considered highly desirable and at one of the largest mills in the country the practice is to take the cotton after leaving the bale breaker, and, by the aid of pneumatic pressure, pass it through two conveyor tubes each three or four hundred feet in length, to another branch of the mill. This accomplishes not only the transference of the cotton but it assists in the mixing and aging of the cotton. This tends to make the cotton uniform as to moisture content and temperature and it also releases the pressure on the fibres. A blower fan effects the transference of the cotton through the duct and the suction of the machine at the opposite end assists in the cotton's movement.

Cotton is often left in the mixing bins for a while to season, the period varying from a few hours to a week or more.

The next process is a cleaning one, its object being to open up any remaining matted fibres and to rid the cotton of remaining impurities. The machine which accomplishes this purpose is known as a picker. In some respects it resembles the cotton gin excepting that, instead of drawing the fibres through the grid, this machine draws off tufts of cotton with great force which, by the action of an air blast, are drawn upon a grid whereupon the heavier particles of dirt fall to the bottom of the machine and lighter parts pass through the cylindrical grid. The cotton is fed into the picker upon a traveling lattice. The beaters revolve at great speed, varying from 300 to 1500 revolutions per minute, depending upon the size of the machine. An exhausting fan mounted in the picking machine maintains a strong blast of air which serves to carry the cotton at high velocity through the curved ducts of the machine and to throw out a large fraction of any remaining dirt into the interstices of gratings which line the passages. The cotton finds its way to and is deposited in patches upon the outside surfaces of two perforated zinc or wire cylinders, which form the cotton into a continuous sheet and remove further impurities. The cotton, after passing through several rollers, is formed into a lapped roll, known as a lap. This lap may be passed through one or more additional pickers and for certain classes of goods is passed through one or more scutchers, in addition. The latter resembles a picker in many respects and its operation is similar. Its chief points of difference are that it has two or three arms to act as beaters instead of a series of teeth and it is equipped with sensitive regulating devices. Its function is to continue the cleaning and form laps of uniform weight and density for the carding engine.

Some scutchers employ beaters provided with stout teeth instead of smooth blades, in which event the operation resembles combing rather than beating.

Three or four laps are usually fed simultaneously into the pickers and scutchers, thus assisting in evening up the product as it ad-

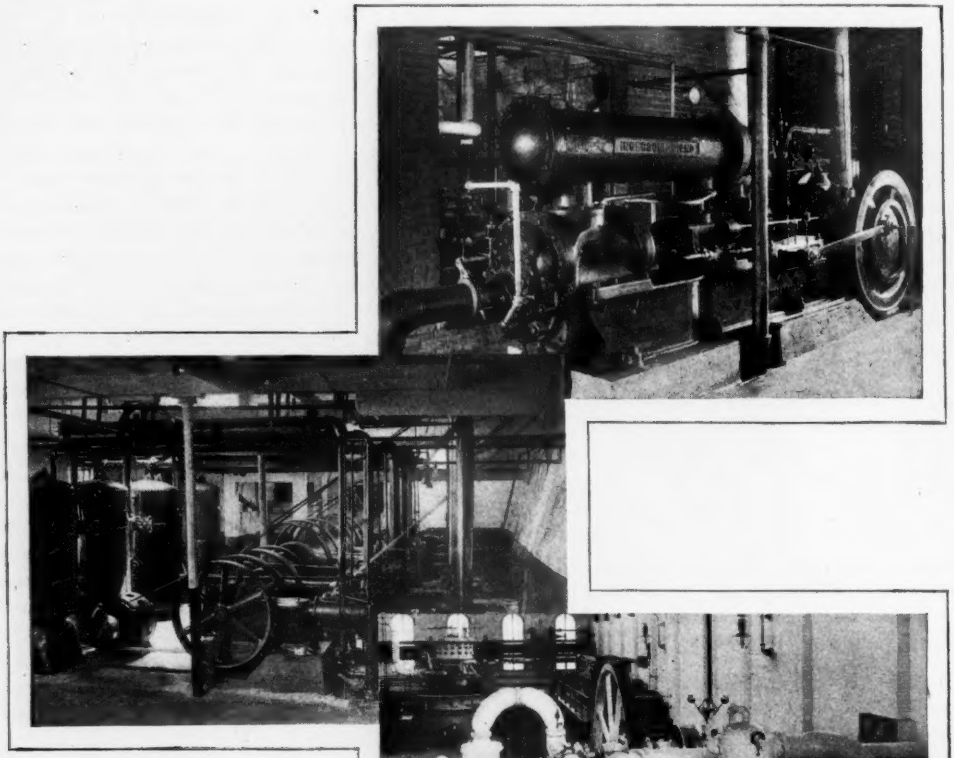

FIG. 3. TYPICAL TEXTILE MILL AIR COMPRESSOR INSTALLATIONS.

vances from stage to stage of manufacture. As a matter of fact, the cotton is usually combined and recombined hundreds of times before reaching the final stages.

The function of the carding engine or card is to arrange the fibres parallel and to remove any remaining impurities and immature fibres. A carding engine consists of three cylinders, which are covered with brush-like cards. These cards are made up of thousands of wires embedded in leather. The cotton lap is fed against the first and smallest of the cylinders, known as the taker-in. This combs out the fringe of the lap and at the same time strikes out the heaviest particles of remaining dirt. The taker-in then carries the fibres to the second and largest cylinder, which is the main cylinder. The fibres are carried around on the main cylinder passing over either a set of stationary cards or a set of moving cards, which, however, advance at a slower speed than the main cylinder. It can readily be seen that the main cylinder, constantly passing over the stationary or slowly moving cards, picks up all fibres lying crosswise and arranges them in nearly parallel lines. The slow moving cards, which are called flats, carry away the short or knotted fibres, which are taken out of the card by a revolving brush. The main cylinder eventually carries the long fibres to the third cylinder, known as the doffer, from which the fleece is stripped by a rapidly vibrating comb and fed through a funnel-like aperture into a can. The product of the card is known as a sliver and is a strand about the size of the thumb. This machine is often modified in design. Special devices are applied occasionally to remove the material that collects between the wires of the card and to grind the ends of the wires so that they will all remain of the same length.

The cotton, now greatly purified, with fibres in fairly orderly arrangement, is run through several additional machines before twisting takes place. The intermediate processes vary greatly according to the kind of yarn desired. For the finer grades of yarn a number of slivers will probably go to a sliver lapper which will combine them into a strip. In leaving the sliver lapper, the strip passes between three sets of rollers which draw it out before it leaves the machine. Several strips from the sliver lapper are combined in a ribbon lapper which delivers a strip a foot or less in width, after attenuating the cotton as in the sliver lapper.

The ribbon laps now pass to the comber in which the cotton passes between the teeth of a comb, which removes the short fibres, known as noils. The comber noils and card strippings are usually sent to another department of the mill to be worked up into yarns of comparatively inferior grades (so called waste yarns).

The drawing frame receives the slivers from the combers and draws several slivers down to the dimensions of one. This refers to the finer grades of product. For lower and medium grades, the slivers are often taken from the carder direct to the drawing frame, omitting the intermediate steps. The slivers from the card and comber both contain the fibres in more or less irregular distribution, and it is the function of the drawing frame to improve the distribution by drawing out the fibres. The drawing is accomplished by passing between several sets of rollers under tension, the lower rollers being of fluted metal and the upper ones of leather. The front rollers revolve six to eight times as fast as the back ones, so the attenuation is great. Six to eight cans containing once-drawn slivers may be put up to a second head and similarly drawn and finally a similar number of twice-drawn slivers may be fed into a third head and again drawn, giving in all from 200 to 500 doublings.

The product of the draw frames in the form of a sliver is now delivered to a slubbing frame or slubber by which it is still further attenuated, slightly twisted and wound upon spools. Each sliver is drawn out by three pairs of rolls and as it emerges from the front pair a flyer, revolving on a spindle, carries the sliver round with it to twist the fibres. This flyer coils the twisted material upon a wooden tube or spool. The slubber product is known as a roving.

The next step is the intermediate frame, which is similar to the slubber, but has a larger number of spindles and smaller tubes. In this machine the four-fold processes of combination, attenuation, twisting and winding are effected consecutively and continuously.

The intermediate roving goes now to the roving frame, which is similar in principle to the slubber and intermediate frames, but it contains a greater number of spindles and the

tubes are smaller than in either. It draws two intermediate rovings into one, twists them and winds them upon wooden spools or paper tubes. This machine is usually the last employed to prepare cotton for spinning.

WEAVING AND KNITTING.

The single yarn is further twisted and sometimes put through other processes, as dyeing, bleaching or singeing, before being worked up into warps or filling. The various processes of weaving and knitting are fairly familiar. There are no direct applications of air to weaving, to our knowledge, excepting cleaning and humidifying, to be referred to later.

In connection with knitting, the Perkins Hosiery Mills of Columbus, Ga., have successfully applied compressed air to their hosiery presses, and state that this is a decided improvement over their old method. They claim that the machine does more and better work at a lower cost. Air operates through a small hydraulic cylinder, 8 by 6 inches in size, and a special valve has been designed to control the action of the press.

One machine worthy of mention is a knot-tying machine which is used in connection with the rolls of warp. The warp is rolled on wooden rollers, the width of the finished cloth, and is fed into the loom where the cloth is built up by the interweaving of the woof, fed through the bobbin. As the end of the roll of warp is reached it becomes necessary to join a new length of warp to it, and the knot-tying machine quickly and accurately finds the yarn ends and joins them to corresponding yarn ends on the new roll.

COTTON FINISHING.

The woven goods as they leave the looms may be put through one or more processes to produce any desired finish. There are many finishing processes in use, a few of which we will endeavor to describe. The simplest is bleaching, for producing white goods. Dyeing plain colors is also an important branch of finishing. Printing various designs in one or more colors is carried on to a large extent, although not as much as formerly, as the designs are often put into the goods in the weaving operations. Starching and calendering to give a glossy finish are applied to many classes of cotton goods and mercerizing is employed to give to the cotton the appearance of silk.

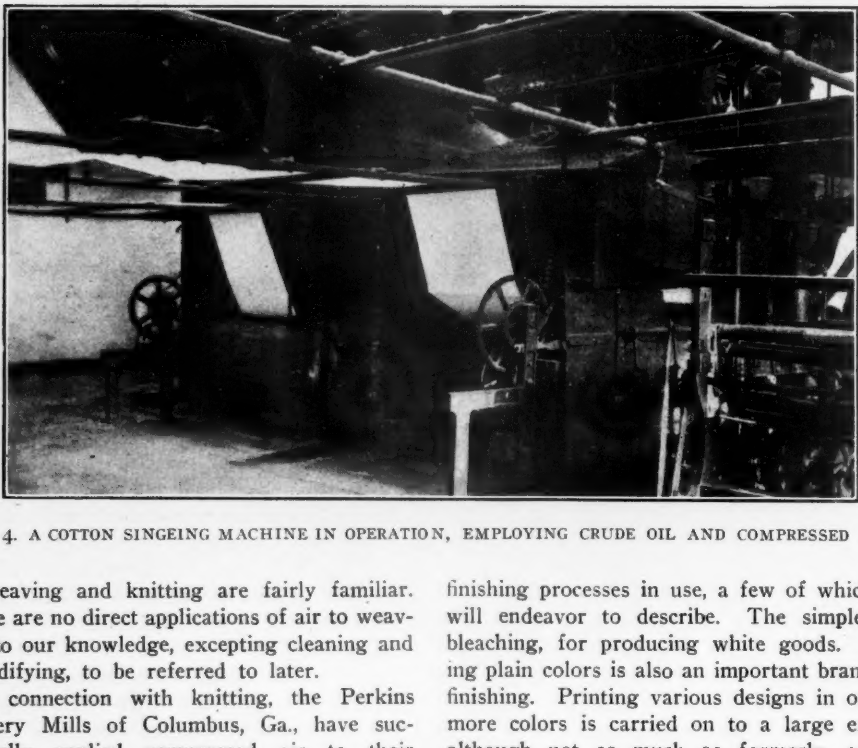

FIG. 4. A COTTON SINGEING MACHINE IN OPERATION, EMPLOYING CRUDE OIL AND COMPRESSED AIR.

Most cotton goods must first be singed to remove the fuzzy particles of material extending from the surface. Ordinarily one side only is singed and that will be the finished side in the final product. Illustrations of two types of singeing machines are shown. One operates with crude oil and the other with a gas

flame. Referring to the crude oil singer, the crude oil is fed through burners under pressure. Around each oil burner is an annular opening through which compressed air enters, producing an extremely hot and long flame. The flames enter beneath three arched copper plates bent into the form of a semi-cylinder

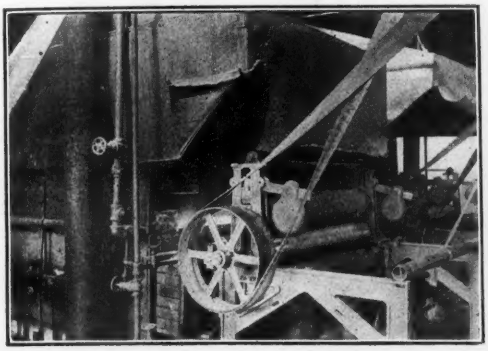

FIG. 5. BACK VIEW OF CRUDE OIL SINGER, SHOWING BURNERS TO EXTREME LEFT AND WATER TROUGH BELOW ROLLERS.

about 6 or 8 inches in diameter and 4 or 5 feet in length and with metal about an inch thick. The copper arches are embedded in cement and are spaced about two feet apart. The cloth to be singed is fed into the machine and runs through it at a speed of perhaps 75 yards per minute. The cloth is made to bear slightly on the singeing plates and, to the uninitiated, the flames shooting from the goods give the impression of destroying the cloth. However, when the singed strip is examined it is found to be in perfect condition, the burnt particles being washed out in a trough of water through which the cloth passes. The crude oil pump shown in Figure 6 has been operating for a long time on compressed air and is giving satisfactory service.

The gas singer shown in Figure 7 has five gas burners and ten rollers around which the cloth passes, later to enter a trough of water. In this particular case only two of the gas flames are burning but it can be seen that the cloth is subjected to a most thorough singeing action. These flames could be arranged in a manner similar to the crude oil burner, but in this case the gas and air are mixed in a separate motor-driven machine known as a gas-mixer, before entering the pipes leading to the singer.

Air has been used in another way in connection with gas singers. The flame is so arranged that air suction deflects a portion of the flame drawing it through the openings in the cloth, thus thoroughly clearing the net or

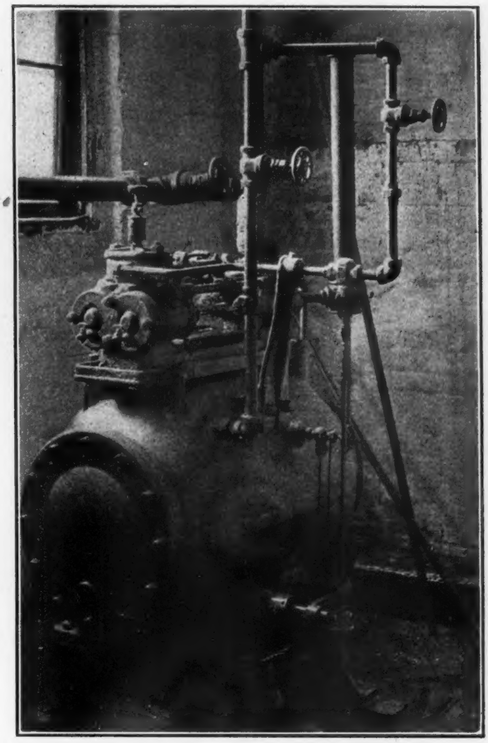

FIG. 6. CRUDE OIL PUMP, OPERATED BY COMPRESSED AIR FOR SUPPLYING THE SINGEING MACHINES.

lace of any projecting fibres and presenting a more "thready" appearance. Sometimes a singeing machine is run in connection with a shearing machine, the shear removing the longer threads as well as much of the nap or fluff.

Singed cloth that is to be made up into white goods must now be bleached in a solution of chemic, which is the cotton manufacturer's name for chloride of lime. The cloth is afterwards washed, dried by passing over cylinders heated with steam or by other means and wound on rolls.

Goods for dyeing are run over rollers

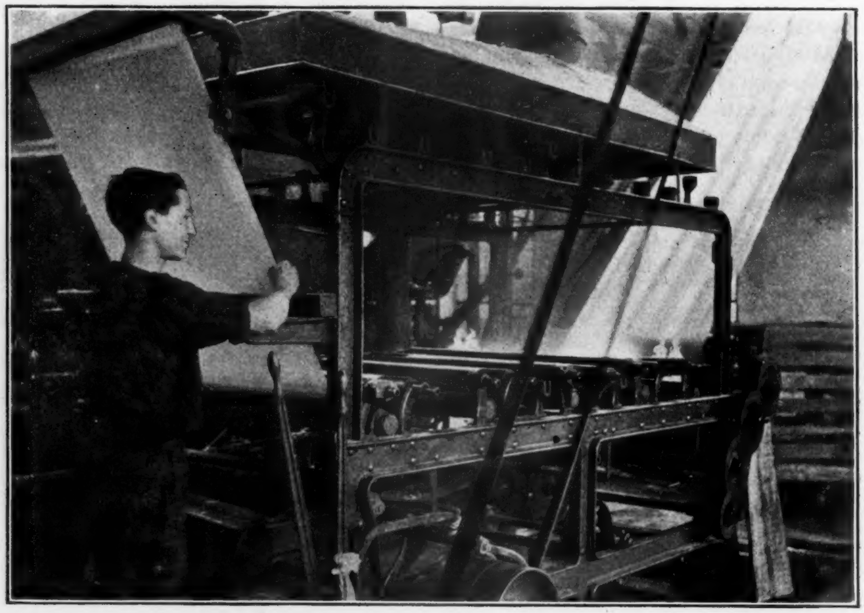

FIG. 7. A COTTON SINGEING MACHINE IN OPERATION, USING A MIXTURE OF GAS AND AIR.

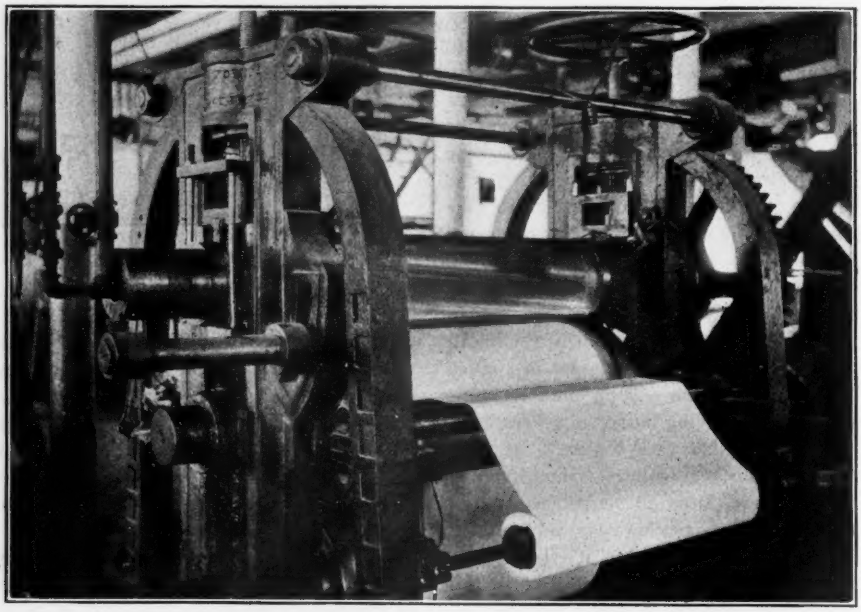

FIG. 8. A CALENDERING MACHINE IN OPERATION. THE GAS FLAME USED TO HEAT THE UPPER ROLLER IS INTENSIFIED BY MEANS OF COMPRESSED AIR.

through the dyeing solution, this operation being repeated several times.

Printed goods are handled in much the same way as a newspaper is printed on a cylinder press. The pattern is engraved or etched on copper or brass cylinders which carry the ink and transfer it to the cloth as it passes over the cylinder. It is not uncommon for a printing machine to print goods in as many as twelve separate colors.

The colors in the dyed or printed goods must be fixed—that is, made permanent. For this purpose the printed or dyed cloth is subjected to the heat of steam in a large box. This box is very large, in fact larger than many of the rooms in the plant and the steam in it is often considerably superheated. Sometimes the action of the steam develops a permanent color totally different from the initial color on the goods.

The colors fixed, the cloth is transferred to the soap house to have the surplus color and any foreign matter washed out of it.

After drying, the cloth enters a starching machine, then passes while still wet to a tentering frame, the function of which is to stretch the strip to the desired width. Often, the strip is stretched in width several inches. The cloth is dried at the same time that it is framed.

Calendering is the final operation. This is an ironing or burnishing operation which gives to the cloth, aided by the starch sizing, the glossy finish of most bolted goods. The metal calender rolls may be heated in various ways, as by steam and gas. The calendering machine, shown in Figure 8, utilizes compressed air to operate the gas burners which heat the rolls.

Mercerizing is a very interesting process. Its purpose is to impart to the cloth a silk-like surface. The process consists in taking the cloth from the bleachery and immersing it in a caustic alkaline solution, as potash, which shrinks the fibres and dissolves their surfaces to a certain extent. After leaving the alkaline solution the cloth must be passed through an acid solution to arrest and neutralize the action of the alkali. Then the cloth is washed and carried through the remaining processes.

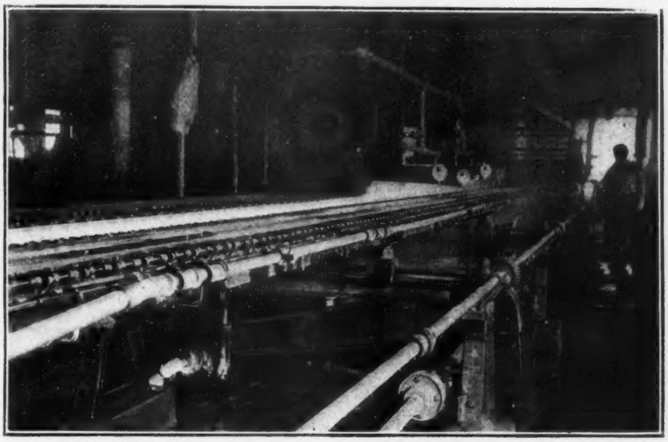

FIG. 9. A TENTERING MACHINE CARRYING A STRIP OF MERCERIZED COTTON CLOTH. PIPES ON EITHER SIDE OF THE MACHINE SUPPLY COMPRESSED AIR TO JETS FOR BLOWING AWAY SURPLUS MOISTURE.

An illustration on the following page shows a strip of cloth coming from the mercerizing solution and advancing along the ways of a tentering machine. The edges of the strip are seized by castiron clips (castiron being best suited to withstand the action of the alkaline solution) which recede transversely as they advance along the frame, thus stretching the cloth to the desired width. These clips are mounted on a chain and run in a guide, motion being imparted by a sprocket wheel which engages the chain. The sprocket is connected by belting with a steam engine. Formerly, surplus solution was removed from the clips by brushes, but great

difficulty was experienced by the brushes wearing out largely due to the caustic action of the solution. It is essential to remove the solution from the clips before they grip the cloth or a mark will be sure to be made on the cloth. The difficulty was thoroughly overcome by blowing the liquid from the clips with air jets. Nine air jets, in sets of three, are arranged on either side of the tentering machine and direct blasts of air at an angle of about 45 degrees against the clips. The air is under about 25 or 30 pounds pressure. This novel application of compressed air has proved thoroughly satisfactory and is employed on several machines in the works in which the

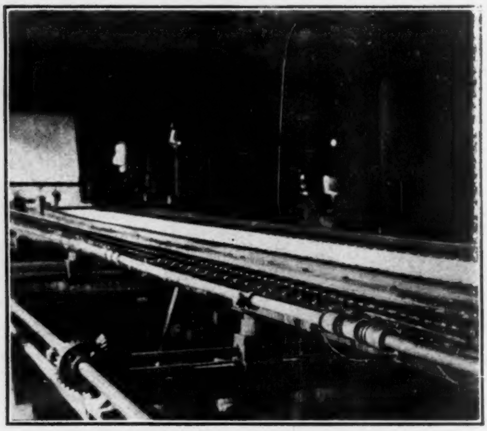

FIG. 10. A TENTERING MACHINE WITH MERCERIZED COTTON STRIP ADVANCING. THE AIR PIPE AND JETS ARE SHOWN IN THE FOREGROUND.

photograph was taken. Fig. 9 shows plainly the shower of warm water for removing the surplus caustic, after which the cloth is fed through an acidified solution. The tentering machine automatically seizes the cloth at the beginning of its travel and releases it at the end.

Compressed air has been further applied in finishing works for agitating, elevating and transferring dyes and solutions and for cleaning presses, slashers and other machines by the air jet.

HUMIDIFYING.

Throughout all the operations of cotton spinning, weaving and knitting it is desirable, in fact almost necessary, to keep the air in the factory at a uniform and fairly high degree of humidity. Artificial humidifiers have made it possible to operate cotton mills successfully in other sections of the country than those originally supposed to be particularly adapted to cotton manufacture. Even in comparatively humid England at least one-half of the mills use some form of artificial humidification.

Cotton is composed of myriads of very close filaments held together by waxy or gummy substances. Too dry or too hot atmospheric conditions cause the filaments to separate, filling the air with particles of dust and lint. This condition is highly objectionable as it increases the difficulty of manufacture, increases the percentage of waste, makes the working conditions much more uncomfortable for the workers, increases the cost of cleaning and increases the fire risk. The rapidly moving machinery and the static effect of driving belts increase the circulation of dust and lint. The static effect is entirely eliminated with high degrees of humidity. There can be no doubt that adequate humidity actually increases the output by strengthening the yarn and it improves the product by causing the fibres to engage together more closely and by giving greater elasticity to the product.

In the early days of cotton manufacture, floors were sprinkled and troughs of water kept near the machines. Now practically every progressive mill in this country has a humidifying equipment of some sort. Several types of humidifiers are in general use. Vapor pots are to be found in some of the older mills but they have many objectionable features. In the first place they heat as well as humidify, for they add a large volume of steam to the air. This is not only an expensive procedure but it adds to the discomfort of the operators in warm weather. Most modern plants have an equipment of one or both of two classes which may be termed the local distribution type and the air conditioning type.

Each of these has its advocates, but local distribution is more generally used, and to this system compressed air has been successfully adapted. Many humidifier systems use water under pressure, and are characterized by bulky metallic casings and systems of drain pipes, all of which require frequent cleaning. Compressed air humidifiers on the other hand, require no drainage system, as all the water delivered is completely evaporated. The water

used is supplied by gravity from small tanks at the level of the supply pipes, which are provided with safety overflows, and the danger of damage to stock and machinery from overflow and leakage is thus obviated. The pipes, being small, occupy so little room that they can be installed in low posted rooms without inconvenience.

heads are located. Parallel with these branch air lines are water lines. These are run dead level.

Water is supplied through a small covered, float-controlled tank. This tank is equipped with overflow pipe, draw-off pipe, filter, etc., and is covered to keep out dust and lint.

One of these tanks will supply from sixty

FIG. II. TURBO HUMIDIFIERS IN THE PLANT OF THE FULD AND HATCH KNITTING CO., COHOES, N. Y. NOTE THE STRAIGHT LINE METHOD OF DISTRIBUTION.

to seventy heads, but in large rooms the best practice is to divide the system into two, three or four separate sections. The tanks may be located in toilet rooms, or other convenient, accessible places. The water line, controlled by the overflow pipe, is located one and one-half inches below the centre line of the head.

It is absolutely impossible for water to overflow from the heads on floors, machinery, stock, etc., for when the air is shut off there is no power to lift the water up to and into the head; when the water is shut off the air has no water to lift—hence no damage either way.

Air is supplied at about 65 pounds pressure at the orifice of the humidifier and, passing tangentially over the end of the water nozzle, produces a partial vacuum, drawing the water up the supply pipe and projecting it into the

For lack of space we will restrict our description to the "Turbo" humidifier, which is a representative humidifier of the type using compressed air. This device was invented by Mr. Albert W. Thompson, Mechanical Superintendent of the Amoskeag Mfg. Co., Manchester, N. H., which is one of the largest textile manufacturing plants in the world. This humidifier is manufactured by the G. M. Parks Co., of Fitchburg, Mass. Mr. Thompson was one of the first engineers to appreciate the applicability of compressed air to textile manufacturing processes and the present extensive use of compressed air in cotton mills is largely due to his pioneer work in this field.

Describing the "Turbo" humidifier system air is supplied through a main pipe to the several branch lines in which the humidifying

air in the form of a fine spray. In several mills visited by the writer the air pressure in the receiver did not exceed 35 or 40 pounds, but no difficulty was experienced with these reduced pressures.

The Turbo valve is located under each head, so that any may be shut down without interfering with the others. Simply shutting off the air shuts down the head. The power required is not considerable, and where the exhaust steam can be utilized for heating feed water, heating mill, etc., the independent steam driven compressor will furnish this power at a negligible cost.

The power load is proportional to the number of heads in operation or the actual work being done by each head. If at times half the heads will do the work—as they will under certain atmospheric conditions—the operating cost is cut one-half.

The spray is so fine it will not settle on floors or shafting, belts or machinery.

In capacity, based on cubic contents which one head will supply, each "Turbo" humidifier will serve from 6,000 to 20,000 cubic feet of space, according to the processes, the department and local conditions.

It is apparent that if the atmosphere is oversaturated, it is harmful to health; but properly humidified air acts in a manner quite the opposite.

A properly humidified air will always be more healthful than a hot, dry atmosphere, and decidedly more so than one containing dust and lint.

FIG. 12. TURBO HUMIDIFIERS IN THE WEAVING ROOM OF THE CHICOPEE MFG. CO., CHICOPEE FALLS, MASS. NOTE THE RING METHOD OF DISTRIBUTION.

Cool, damp air has a tendency to fall. In settling it will prevent the formation of dust and lint.

The most desirable system of artificial humidification is one that can be started before the mill starts. This brings about the proper conditions of humidity by the time the operatives arrive. A system that depends on mill power will cause the humidity to "lag" until the proper conditions are brought about. This is especially marked on the morning after a holiday, or on cold, dry mornings in winter.

Live steam introduced into the mill atmosphere is always under control; but since it increases the temperature it tends to defeat its own object. The increased temperature

continually calls for larger amounts of moisture to maintain the desired relative humidity Moreover, it has been found to be detrimental to health; a source of discomfort; inordinately expensive, and in England, we understand, is prohibited by law.

The expansion of the air combined with the evaporation of the water in the "Turbo" humidifier absorbs considerable heat from the atmosphere and actually reduces the temperature of the room from a fraction of a degree to several degrees.

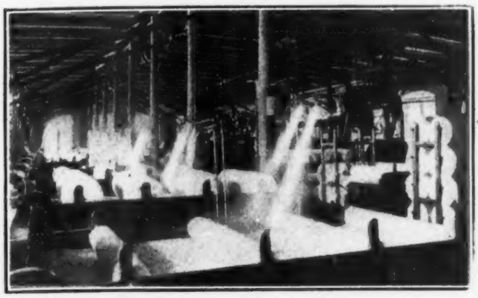

FIG. 13. MOISTENING BLEACHED AND COLORED COTTON LAPS ON FINISHER PICKERS.

This is greatly appreciated by the workers in the warm season. In cold weather it is customary in some mills to heat the water with steam coils inserted in the supply tanks, before evaporating it.

MOISTENING STOCK.

Figure 13 illustrates a useful modification of air humidifiers for the purposes of stock moistening, for which a special head is used to give a coarser spray than that produced by the standard humidifiers. These are often of great use in carding colored and bleached cotton, and the cut referred to shows a row of finisher pickers on which the back laps are moistened by humidifiers.

VENTILATION.

Efficient ventilation is highly desirable in the cotton mill, not only for the health and comfort of the operatives but also to remove the minute particles of dust which will be given off to some extent even in the best equipped mill. Exhauster fans are used largely for this purpose and many mills are equipped with air conditioning apparatus which supplies fresh air, heated and humidified before being introduced.

CLEANING.

Cleaning has always been a troublesome problem in the cotton mill, and its satisfactory solution was not found until compressed air was applied. Many attempts were made to apply vacuum cleaning, which has met with such marked success in domestic and some industrial operations, but it cannot successfully clean in and around cotton machinery, as the air jet does. The cleaning feature has been found to be an additional advantage with the "Turbo" humidifying system. Outlets may be left at convenient places, so that hose may be attached, and compressed air used for cleaning machinery or in inaccessible places. This is found to be very advantageous in plants where it has been adopted.

Tentering machines, stock dryers, and machines of this type usually require from one to two hours per week for cleaning. These may be more thoroughly cleaned in fifteen to twenty minutes by the use of air nozzles than is possible by hand.

Nappers requiring a half-hour's stoppage per day for hand cleaning may be cleaned in from five to ten minutes per day by the use of compressed air.

Ring spinning frames, usually requiring from one hour to an hour and a half per week stoppage for hand cleaning, may be cleaned in from twenty to thirty minutes a week—about two per cent. increase in production.

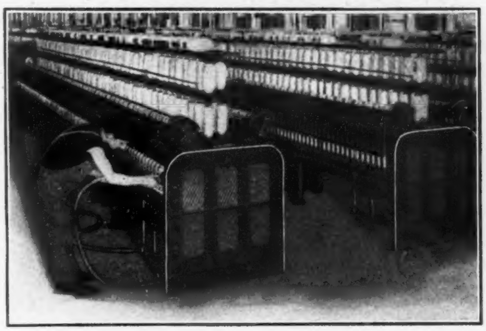

FIG. 14. CLEANING MAIN BEARINGS AND UNDERWORK OF A RING SPINNING FRAME.

As an instance of what may be done, we cite an actual case of a room containing 50,000 ring spindles on 26's yarn, where the number of hands required in cleaning and sweeping was reduced from fourteen to nine after air-cleaning service was installed.

A weaver can clean a loom in less than two minutes with a nozzle more thoroughly than in twenty minutes by brush. This cleaning may be applied as often as desired, resulting in an improved product, and more of it. Whenever the warp runs out, the cleaning nozzle may be brought into play, and all parts of the loom can then be subjected to a still more thorough cleaning.

Insurance men affirm that rooms cleaned by compressed air are found much freer from the conditions inviting the starting and the spreading of fires.

Pulleys, shafting, and ceilings also may be cleaned by air applied through a light brass tube in a hollow wooden pole.

FIG. 15. GETTING INTO THE CORNERS OF A COTTON MACHINE WITH THE AIR NOZZLE.

Less stoppage is necessary than where the overhead cleaning is done with brooms and brushes, as the work is done in much less time and very much more thoroughly.

The lint dislodged by the nozzles is so heavy that it settles at once to the floor. The operator soon learns to keep the point of the cleaning nozzle depressed, and no trouble then results.

The nozzle used for air-cleaning service has a small stop valve, controlled by the thumb of the operator, and an extension of about 15 inches of quarter-inch pipe reduced to a very small opening at the tip. This nozzle consumes from twelve to fifteen feet of air per minute, which corresponds to less than two horsepower. Care must be taken to have air for cleaning purposes free from moisture.

For cleaning motors and other electrical machinery when exposed to the dust and the lint inseparable from textile mills, air cleaning is an essential rather than a convenience and is widely used for this purpose.

In some mills the operators clean their own machines as occasion requires. In others, a regular cleaning staff is maintained, whose duty it is to go through the various departments systematically. Generally the walls and ceilings are cleaned down by extra hands after the mill has shut down, the looms, spinning frames, etc., being covered with cloths.

FIRE EXTINGUISHING APPARATUS.

Many cotton mills make a practice of keeping the automatic fire extinguisher pipes filled with air. The extinguisher system is connected with the air system and the extinguisher pipes are (or should be) inspected daily, to make sure that they are filled with air. The object of this arrangement is to avoid the possibility of the pipes becoming frozen and inoperative and also to prevent leakage on the stock should a pipe or head spring a leak. Of course, in the event of a fire, the air would have to be expelled from the pipe before the water could become effective but this would require a very short time. Some cotton mills use compressed air only in the store house extinguishers where there is the most danger from the possibility of freezing.

THE AIR LIFT FOR WATER SUPPLY.

Air has been used extensively in various industries for pumping water by means of the air lift. Cotton mills require an abundant and reliable water supply and for this purpose the air lift is often the ideal equipment. It is peculiarly adapted for lifting water from driven wells, especially those of great depth. Where an air compressor is already installed to supply air for other operations, as is the case in most cotton mills, an air lift system obviously has additional advantages. The air lift is characterized by extreme simplicity as there are no moving parts whatever, simply the water supply pipe and the air pipe which carries the air to the bottom of the water supply pipe mixing with the water and raising it to the surface. The water from an air lift system is as pure as the source of supply, and in some cases it is actually purer as the aeration of water always results in purification. The water is also slightly cooled due to the ex-

pansion of the air. No attention is required and there can be no trouble from wear and leakage due to sand or grit in the water. Air lifts are suitable for very deep wells and for very high lifts.

The air lift system of water supply at the

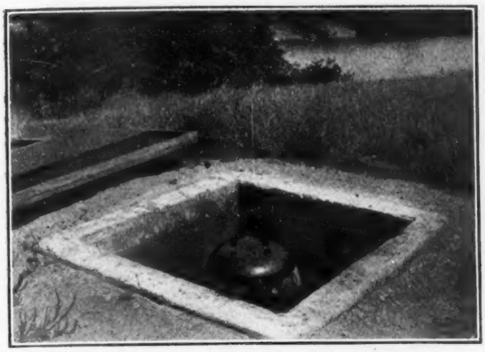

FIG. 16. ONE OF THE SEVENTEEN WELLS AT THE PLANT OF THE U. S. FINISHING CO., PAWTUCKET, R. I.

United States Finishing Company's plant at Pawtucket, R. I., is a typical one and for that reason a brief description of it will be given. The water supply from a pond located near the works and fed by a spring was found to be insufficient for the Company's needs, so seventeen wells were sunk varying in depth from 117 to 300 feet. One of these wells is "dead," leaving sixteen in operation. The principal use is in the bleach house, which consumes large volumes of water. In the daily run of eleven hours, the air lift supplies 2,000,000 or more gallons of water to the works.

The air lift is of the Harris "Twentieth Century" type and the compressor is an Ingersoll-Rand Class "OC" Corliss steam driven, two-stage machine, with both steam and air cylinders compounded. The stroke is 24 inches; the low pressure steam cylinder is 30 inches in diameter and the low pressure air cylinder is 27¼ inches diameter. The high pressure steam cylinder is 18 inches diameter and the high pressure air cylinder is 16¼ in. diameter. An intercooler is mounted above and between the two air cylinders.

The compressed air is carried directly to a receiver in the yard. A two-inch main conducts the air from the receiver to the works and a six-inch wrought iron main carries the air to the wells. There are two drains in the receiver and, as all the air lines drain back to the receiver, there is never any trouble from condensed moisture if the drains are opened two or three times a week.

A main valve in the air line near the wells controls all of them. Branch air lines 1¼

FIG. 17. THE OVERFLOW POND AT U. S. FINISHING COMPANY'S PLANT, PAWTUCKET, R. I. THE COMPRESSOR HOUSE ADJOINS THE CHIMNEY IN THE BACKGROUND.

in. lead from the main to the individual wells. The water pipes in the wells vary in diameter from 2 to 4½ inches. The water main leading to the bleachery is 12 inches in diameter. As the water is lifted from the well, it strikes the under side of a mushroom-shaped discharge plate, known as a deflector head, and falls into a concrete pit, which is covered over with a wooden cover.

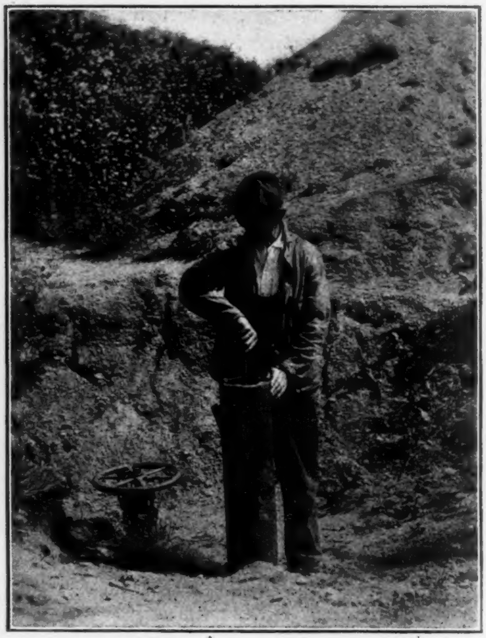

FIG. 18. OPERATING THE VALVE CONTROLLING AIR SUPPLY TO THE WELLS, U. S. FINISHING CO., PAWTUCKET, R. I. WATER OVERFLOW VALVE ALSO SHOWN.

When the full supply of water from the wells is not needed in the bleachery, the excess water overflows into the storage pond.

A pressure of 75 pounds per square inch is maintained in the air receiver and this is sufficient to operate the wells satisfactorily, although the pressure has to be increased to 90 or 100 pounds to start the wells running.

COMPRESSED AIR IN MILL CONSTRUCTION.

In mill construction, pneumatic service is invaluable to the manufacturer conducting his own building department. Or, if the plant is being built under contract, the use of compressed air by the contractor may be made valuable to the owner in reducing the initial cost of construction.

A prominent cotton mill engineer recently stated that "the economy secured by the use of pneumatic tools in the construction of a 25,000 spindle mill would pay the entire cost of purchase and installation for a compressed air plant of sufficient capacity to be subsequently used for cleaning and humidifying for the entire mill."

Pneumatic wood-boring tools may be used advantageously in mill construction. With such a machine, one man can easily fit the timbers for anchors and dogs and do work which would require at least two men with hand tools.

Boring tools of the same kind may be later used for hanging shafting. The hangers are usually supported by two three-quarter inch

FIG. 19. A PORTABLE MILL DERRICK OPERATED WITH AN "IMPERIAL" PNEUMATIC MOTOR USED IN COTTON MILL CONSTRUCTION.

lag bolts. The holes are bored with a five-eighths inch auger. The lag bolts are screwed home by means of a blind nut which fits a socket on the spindle of the boring machine.

In this manner a gang of seven men may put up from 80 to 100 hangers in nine hours.

Another convenient use for pneumatic service in mill construction is a portable mill derrick mounted on trucks to set columns and timbers. A derrick fitted with a pneumatic motor, does this work very quickly. With a hand derrick, a gang of ten men could set about five timbers an hour. With a pneumatic derrick, as many as twenty have been set in an hour, and a rate of twelve to fifteen may easily be maintained.

This apparatus is also convenient for hoisting bundles of plank from the floor last com-

(*Continued Page 7006.*)

FIG I. HEADING AT GRADE. NORTH PORTAL BLOUNT TUNNEL.

THE BLOUNT AND THE MT. HAYDEN TUNNELS

Some interesting engineering operations are usually involved in the relocating of portions of established railroad lines. The new layout of the Louisville & Nashville Railroad between Blount Springs and New Castle in northern Alabama, on the main line between Birmingham and Cincinnati, shortens the mileage, obtains better grades and gets rid of some bad curves. There are here located two tunnels known as the Blount and the Mt. Hayden, and these, although so near together that one power plant suffices for the construction of both, are quite different as to the material encountered. The finished section of the tunnels, double track, is $27\frac{1}{2}$ by 33 ft., the former being 1,015 ft. long and the latter 2,100 ft.

THE BLOUNT TUNNEL.

The Blount tunnel is through hard limestone and black flint, so solid and hemogeneous that no lining is required, and it is driven by means of a bottom heading. The Mount Hayden, the longer tunnel, is through a constantly changing material, hard in places and at others so soft as to afford little support for the bracing This is being driven with a top heading, and it will have to be lined practically all through.

Fig. 1 shows the heading at grade at the north portal of the Blount tunnel. The heading was first driven all through the tunnel to a height of 7 ft. above subgrade and in general to the full width of the double track tunnel. Six $3\frac{1}{4}$-in. Ingersoll-Rand drills were used, mounted on columns, with two men to each drill. There were 30 holes drilled to each round to a depth of 12 ft., starting at $3\frac{1}{4}$ in. and bottoming at 2 in. The feed of the drills called for changes of steel for each 24 in., but it sometimes took from two to six steels to do the 24 inches of depth.

The frequent and constant renewing of the steels as required promoted a keen appreciation of the No. 5 Leyner Drill Sharpener employed on the work. About 400 lb. of 60% Forcite $1\frac{1}{4}$-in. was used for blasting each round, electrically fired. The heading was driven through in 130 working days, employing two shifts.

While this heading was being driven from the north end the south approach cut was being opened, and then a narrow gage track was laid all through the tunnel. Beginning at the south portal for the removal of the

top, section holes for blasting are driven upward at an angle of about 30 degrees with the vertical, the angle being toward the south portal. From side to side of the tunnel there are six of these holes in each row, and the rows are about 7 ft. apart. All of the holes in a row are charged and set off simultaneously, the loosened rock falling to the floor of the tunnel, where it is picked up by a Marion 41 shovel operated by compressed air, loaded on side-dump cars on the narrow-gage track and hauled out by a dinkey to be dumped into permanent embankment beyond the cut. By keeping the shovel the right distance behind the blasting the top of the loosened pile is kept just high enough to allow laborers on top of it to scale off the loose rock from the roof of the enlarged tunnel.

The longest holes are 22 ft. deep, and as the feed of the drill is 2 ft., eleven lengths of steel are required. As the free space below is only 7 ft. the longer steels have to be sprung and coaxed to get them in. The steel is 1 in. diameter and requires to be of high grade to stand the springing and the jar of the hard rock, the Leyner drill sharpener encouraging frequent renewals of the bits and the maintenance of the gage so that there is little time lost by the sticking of the drills.

THE MT. HAYDEN TUNNEL.

The Hayden Mountain tunnel is being driven from both ends with top headings. The north-approach cut is small and the portal was easily reached. That at the south end, however, is 3/4 mile long and involves more than 200,000 cu. yd. In order to get to work at the portal, an incline at about 30 deg. with the horizontal was driven. Up to May 1 the south heading had advanced about 1000 ft. and the north one 400 ft., leaving 700 ft. between the two.

The material appears to change in character about every 200 ft. In some places it is hard and solid and requires no temporary bracing; at other points it is so soft that difficulty is experienced in getting adequate support for the bracing. Water drips abundantly from the roof of the heading at some points, while at others it is entirely dry. One of the worst spots encountered was at the north portal. Here the material is soft and wet, and that above gave indications of a desire to slide longitudinally into the cut. The bottom section at the portal was, therefore, excavated and the portal was built at once about 50 ft. farther out than was originally intended. In order toget sufficient bearing for the concrete lining in the soft material, footings 6 ft. wide were laid. The lining has been placed a short distance in, and it is believed that the tunnel and cut are now sufficiently protected against any slide.

At this end the material is being hauled out in cars by mules and dumped off the end of the fill near by. At the other or south end, however, the situation is much more complex. The line as located from the tunnel south follows a narrow and winding ravine, and the subgrade will, when the cut is finished, be from 35 to 40 ft. below the original bottom of the ravine for a distance of 1/2 mile or more. Thus far the cut has been taken out to about half its final depth only, the spoil being used up in the embankments beyond, the quantities of which exceed those of the short cuts between them. Most of the remainder of the material will have to be hauled 3 miles to a 250,000-cu. yd. embankment. This embankment, which will be 3000 ft. long and up to 52 ft. high, is notable in that it will be along a ridge and will require absolutely no opening for drainage. The approach cut, which is hard sandstone, is being taken out with a Marion 60 steam shovel, and hauled away by narrow-gage dinkeys in eight-wheeled 8-yd. side dump cars of the Oliver and Western makes.

In order to get started on the south end of the tunnel before the cut could be opened the incline previously mentioned was opened up and a narrow-gage track laid on it. The track was carried on up the hillside by means of a double switchback. Loaded cars are hauled out of the tunnel and up the two inclines by cables operated by a stationary engine, and the material is wasted off a trestle at the high level, the empty cars returning by gravity.

COMPRESSOR PLANT.

The compressor plant for both tunnels, comprising four straight line machines with a free air capacity of 5,000 cu. ft. per min., is located along the present line of the railroad at tunnel. The air is piped from the plant to Blount Springs, about 1 mile from Blount the Blount tunnel and from there to the Hayden Mountain tunnel, and some distance beyond (4 miles in all), supplyng the drills in the tunnels and the cuts, the drill sharpener,

FIG. 2. SOUTH PORTAL BLOUNT TUNNEL FULL SIZE.

and the Marion 41 shovel in the Blount tunnel. From the compressor plant to the first tunnel an 8-in. cast-iron pipe is used; from the first to the second, a 6-in., and beyond that a 4-in. The pipe is laid on or near the surface of the ground, and several expansion joints have been placed in the long straight stretches. Such a joint is made by an offset in the pipe line, the gap being closed by an elbow turned upward at each of the unconnected ends of the main pipe, and a short straight length with an inverted elbow at each end engaging the first two elbows. The short length is above the main pipe line and about at right angles thereto, changing its direction as the main line pushes together or pulls apart. The arrangement of plant and pipe line has worked very successfully, with little loss of pressure for the 4 miles.

All of this work is being done by Messrs. Thrasher & Gunter, contractors, of Knoxville, Tenn., under the general supervision of Mr. John Howe Peyton, chief engineer of construction of the Louisville & Nashville Railroad, and under the more immediate direction of Mr. T. Q. Harrison, engineer of construction of the South & North Alabama Railroad, which is the corporate name of the subsidiary company handling the work. Mr. Asher Dole is resident engineer on the work.

STOPING DRILLS*

BY ALBERT E. HALL.

A stoper is cheaper to operate, since it can be handled by one man instead of two, as required on a large machine. In some cases a helper is assigned to two or three stopers, but as a rule this is not advisable. In addition, the use of stopers permits a large proportion of the total time to be spent in actual drilling. With a big drill, much time is consumed in setting up after a blast or after moving to a new working place; with a stoper, on the other hand, the preparations for drilling are simple. As a rule, a stoper can be rigged up and set to work 30 to 40 minutes earlier than a big drill. One disadvantage of the stoper, when used for shrinkage stoping, is its tendency to create a large amount of shattered and partly loosened rock on the roof and walls of the working place. The men must first scale off this loose ground, which takes from 30 minutes to an hour. With a sufficient number of working places, however, this scaling can be done by a special gang, while the machine men are drilling in a previously scaled place.

As a result of the extra time applicable to drilling, and also of the more rapid drilling, stopers make an average of 30 to 40 linear feet

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of hole per shift, while a large drill will make 20 to 30 ft. As a rule, stopers work on a bench in the back. When necessary, a bench is created by taking out a diamond cut, and is then followed across the stope. The holes are made about 6 ft. deep. The amount of powder used (40% dynamite) as computed from several groups of holes, averages 0.63 lb. per cubic yard of ore. The amount of air consumed by a stoper is estimated to be about two-thirds of that used by the largest drills.

Some workmen object to the stopers on the ground that stoppages for small repairs are too frequent. It is true that the dust, which is a disadvantage in itself, from the runner's standpoint, sometimes clogs the valve and prevents the extension leg or standard from working properly, but only a few minutes are needed to clean out the valve, and if a screen or a bit of waste be put into the hose, this trouble is almost eliminated. Water sprays can also be used. On the basis of total repair bills, the stopers do not compare unfavorably with the larger machines.

In many places it is impracticable to use a stoper, and a big drill becomes necessary; for example, in hard rock, where the light drill makes little or no headway; but in shrinkage stoping the smaller machine does excellent work. The stoper has one advantage which is probably realized fully only by the men working underground: this relates to the matter of block-holing. Where the muck is being drawn off through chutes, the size must be fairly small so as not to block the chute and so hinder tramming and hoisting. With small stoping drills, the ground is generally broken small enough to pass readily through chutes, and very little block-holing is required. With large machines, on the other hand, considerable block-holing is necessary.

A BONUS SYSTEM FOR EFFICIENCY ENGINEERS

John Archibald was an efficiency engineer —at least that is what he called himself. There is no question but that he was very efficient in making his presence known whenever he was around. He made a business of placing old-fashioned plants upon a basis where they could double their dividends—at least that is what he said he did, and on the strength of what he said about himself, he was called into consultation by the owners of the Smith & Brown Co., which has done a profitable business for the last twenty-five years.

One sunny morning Mr. Archibald appeared at the Smith & Brown plant and began taking notes of the very inefficient methods that they were using; and he was quite frank about letting them know that he could see opportunities for improvement right and left. He studied the conditions for a week or so and then he made his report, which was to the effect that he saw chances for decreasing costs to the extent of $40,000 or $45,000 a year. He also reported that this improvement could be made if he were hired as efficiency expert and given two assistants of ordinary training and intelligence. He further intimated that his services would be worth $5,000 a year and, as his assistants could be hired for very little money, a saving of at least $40,000 a year could be accomplished with an almost negligible initial expense. This report ought to have pleased the Smith & Brown Co., and it undoubtedly did, but the prospects of the coming prosperity somehow burst so suddenly upon the owners that they were unable to decide right away as to what to do. They agreed, however, to write to Mr. Archibald within a few days stating their intentions. In a few days Mr. Archibald received the following letter from Mr. J. P. Smith, the President of the Smith & Brown Co.:

MR. JOHN ARCHIBALD,
24 Blank St., New York City.

DEAR SIR: We have carefully considered your report regarding the possibilities for increased efficiency in our plant. We think, however, that the compensation which you expect for your services is entirely too modest and is not commensurate with the great saving that your knowledge and ability would accomplish in our plant. We therefore propose that instead of paying you a fixed salary of $5,000 a year, as stated in your memorandum, we share with you the entire resulting savings of the first year, after the system which you will install has been put into operation, you receiving one-half of this saving. We think that this arrangement will be entirely agreeable to you and expect to hear from you at an early date.

Yours very truly,

J. P. SMITH, Pres.

It has always seemed very peculiar to Mr. Smith that he never heard from Mr. Archibald.—*Machinery.*

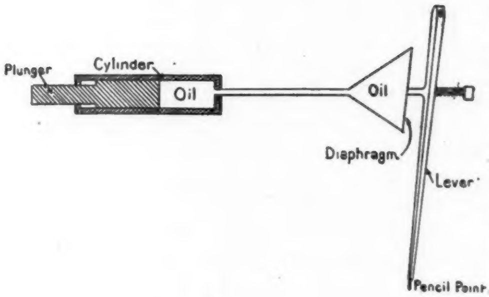


FIG I.

ROCK DRILL TESTING AT NORTH STAR MINE

BY ROBERT H. BEDFORD AND WILLIAM HAGUE.*

The following article, describing efforts made to throw light on some of the dark spots connected with rock-drills and drilling, may prove interesting to those with whom the drilling problem is relatively important. At the North Star mine, Grass Valley, California, where these tests have been carried on, the ore is a narrow vein of quartz between walls of tough diabase in the upper, and no less tough granodiorite in the lower levels. The amount expended last year at this mine upon drilling, namely, for labor, power, repairs, lubricants, hose, and tool sharpening, was 20% of all outlays made. It is, therefore, of the utmost importance that the drills shall be kept in the best repair. The work of collecting details of drill-repair data started about two years ago. Early in the investigation it was found that drills which sounded all right when run against a block in the repair shop, frequently did but poor work underground. A great part of the loss in the mine was directly due to inferior condition of machines. There was needed some testing device which would give reliable information concerning the condition of a drill. W. D. Paynter, the "drill doctor," accordingly set himself to the task of devising such a machine.

THE FIRST TESTER.

The tester as originally constructed consisted of a plunger, cylinder, and diaphragm, the system being filled with oil. This is shown in Fig. 1.

The blow of the drill, through the plunger and oil, expends its energy in distending the diaphragm. The number and magnitude of these movements of the diaphragm, when suitably recorded, give a graph of the work done by a drill. The magnitude of each diaphragm

*Acknowledgment is made also to the engineering staff of the North Star Mine.

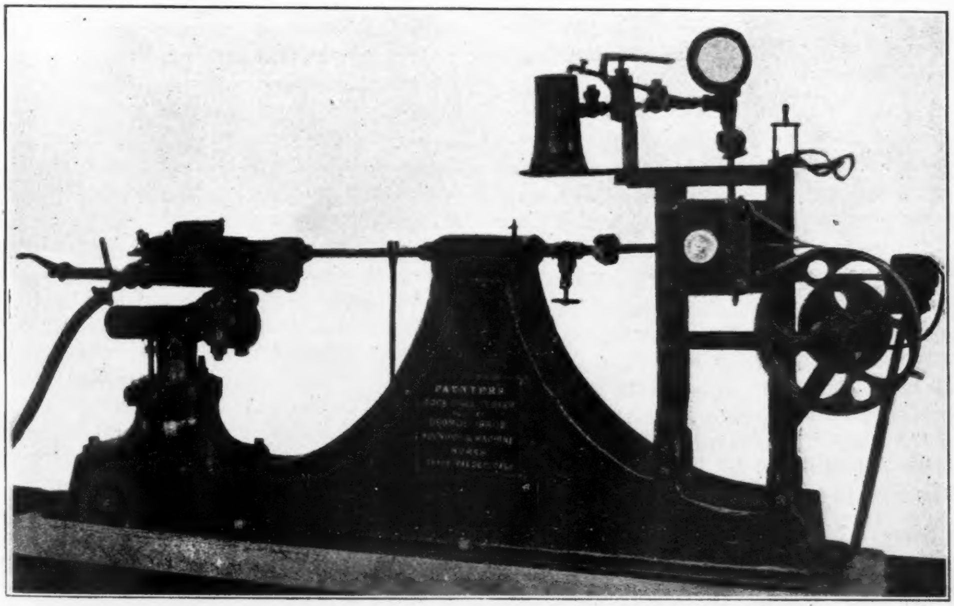


FIG. 2.

movement is measured by a lever, so arranged as to record the displacement in an amplified form upon a strip of paper fastened to the periphery of a rotating drum. The graph so obtained, in addition to showing the number of blows per minute and the strength of each blow, shows any abnormal action of the drill. Results obtained with this crude apparatus were encouraging enough to warrant the building of a more elaborate and precise machine, the essential features of which have been patented by Mr. Paynter. This machine is able to test both air-feed stopers and reciprocating drills.

Fig. 2 is a half-tone of the perfected machine, with a feed-screw machine in place to be tested.

Fig. 3 is the card of an air-feed stoper, No. 205. This card was obtained in the following manner. The drum was rotated with no pressure on the system, the resultant trace is marked "O air pressure." Air was then admitted to the feed barrel and the drum rotated to give the trace marked "feed barrel pressure." With the drum turning, the drill was started, giving the trace marked *A B C*, etc. The length of the line *A B* represents the magnitude of the kinetic energy of the blow delivered by the hammer. The reaction of the diaphragm in assuming its normal position is shown by the line *B C*. That the strength of the blow might be given in foot pounds, the tester was calibrated by means of a pendulum.

Fig. 4 is a card obtained from another machine of the same type but showing a small intermediate "reactionary" blow, which has not as yet been explained. The drilling speed in hard rock should be compared to that given with Fig. 5.

Fig. 5 is a card of a machine in poor repair. It is of interest because it plainly shows a great departure from the graphs obtained from good machines of which Fig. 3 and 4 are examples. The great variation in the actual drilling speed obtained by the machines shown in Fig. 4 and 5 in hard rock confirms what the tester indicates by the relative strength of blow.

Below are given in tabulated form the results of tests on various machines. Unless otherwise stated, the machines tested are air-feed stopers of various construction.

TABLE I.—MACHINE NO. 85,042.

Gage	Blows per min.	Ft-lb. per blow.
98	2280	29
90	2244	27
85	2208	25
74	2100	21
66	2016	20

It should be noted that the strength of blow seems to be more affected than the number of blows by the gage pressure. Thus, in this instance, a 32% drop in pressure caused a 31% drop in the strength of blow, but only a 12% drop in the blows per minute. This has been the case with every type of machine so far tested.

Table II shows the effect of various gage pressures upon drilling speed in hard rock.

TABLE II.

Machine.	Gage pressure.	Blows per min.	Ft-lb. per blow.	Ft. drilled per minute.	Remarks.
No. 501..	95	1210	39	0.36	Sharp steel.
..	80	1170	34	0.34	
..	70	1115	27	0.19	
No. 501..	90	1200	38	0.26	Same steel as used in first test.
..	80	1170	34	0.23	
..	70	1115	27	0.14	
No. 201..	95	1190	39	0.20	
..	80	1150	34	0.20	
..	70	1100	27	0.15	

In this table the blows per minute and the foot-pounds per blow at the various pressures are taken from curves plotted from the results of a number of tests made on machines of this type of construction.

From these results it appears that the drilling speed in this particular rock, and for this particular type of machine, depends largely upon the strength of the blow, within certain limits. The data are insufficient as yet to say more on the subject. In general this table confirms the results shown in Fig. 4 and 5.

LOSSES DUE TO DEFECTS.

The following tests show what loss may be caused in drilling speed by various defects in machines. Drill No. 516 was tested to find the effect of different conditions of feed packing leather.

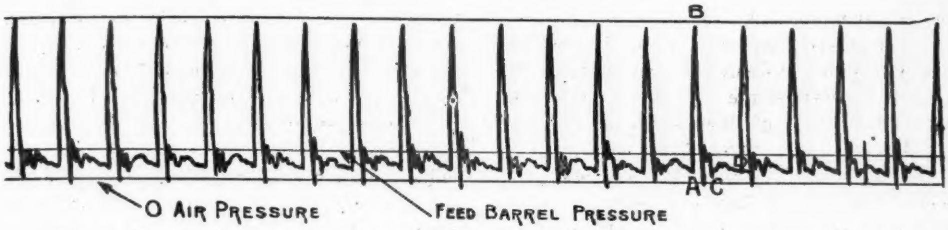


FIG. 3. No. 205. AIR PRESSURE, 100 LB. BLOWS PER MINUTE, 1284. FOOT-POUNDS PER BLOW, 50.

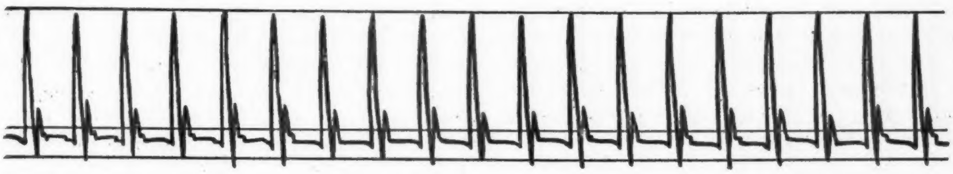


FIG. 4. No. 217. AIR PRESSURE, 96 LB. BLOWS PER MINUTE. 1260. FOOT-POUNDS PER BLOW, 40
DRILLING SPEED IN HARD ROCK, 105 FT. PER MINUTE AT 84 LB. PRESSURE.

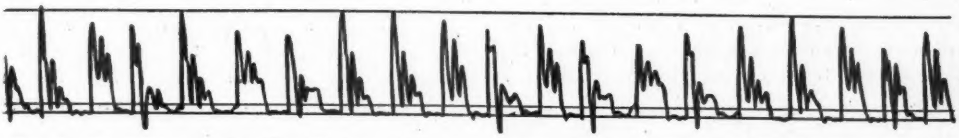


FIG. 5. No. 227. AIR PRESSURE, 84 LB. BLOWS PER MINUTE, 1272. AVERAGE FOOT-POUNDS PER BLOW, 15.
DRILLING SPEED IN HARD ROCK, 0.05 FT. PER MINUTE AT 84 LB. PRESSURE.

Packing.	Gage.	Blows per min.	Ft.-lb. per blow.
New	95	1356	44
Old	95	1332	39
Damaged	95	1296	34

Drills No. 507 and No. 09152, the latter a feed-screw machine, which had been reported from underground as being in "good shape," but unable to do satisfactory work, were tested before and after equipping with new cylinders. Both these machines were reported as "doing well" when again used in the mine. It should be noted that the blows per minute vary but little.

Machine.	Cylinder.	Gage.	Blows per min.	Ft.-lb. per blow.
No. 507..........	old	98	1212	21
....	new	95	1176	36
No. 09152........	old	95	1248	16
....	new	97	1224	36

As only one test was made to find the effect of various lubricants upon a new machine, the following figures are interesting, but not conclusive. A worn cylinder might give less pronounced differences.

Lubricant.	Gage.	Blows per min.	Ft.-lb. per blow.
Heavy	95	1116	25
Medium	95	1212	34
Light	95	1224	38

The statement is frequently made that excessive air consumption indicates that a drill is in bad condition. From a large number of tests, machines of type No. 200 and No. 500 have been found to have an average air consumption of 75 to 80 cu. ft. free air per minute at 90 lb. gage pressure. A test of a machine of this type using 90 cu. ft. of free air at the same pressure, gave 1,296 blows per minute and 43 ft.lb. per blow. From this it would seem that increased air consumption does not necessarily indicate that a machine will do poor work.

As a further example of the usefulness of the tester, this instance is cited. Four new valves were obtained from the manufacturers and were placed in machines. The tester

showed that one failed to meet the standard set. Upon investigating, a piece of steel cutting was found concealed in one of the ports. This had throttled the air sufficiently to reduce the strength of blow about 35 per cent.

Although many tests have already been made, the data are by no means complete. We believe, however, it has been shown that by means of this device it is possible to set a standard which all machines must attain before leaving the shop, thereby facilitating the problem of drill maintenance. No figure in dollars can at present be given for the saving effected; but it may be stated that complaints from the mine about the condition of machines have been materially reduced.—*Mining and Scientific Press.*

AN AUTOMOBILE COMPRESSED AIR STUNT

Electrical Record tells about a man who had a fine country place and also two automobiles which he got into the habit of employing for various incidental service. One day when the Franklin machine was running the lawn mower the Pierce was employed upon a job which was out of the usual lines.

It seems that the house, a big roomy one, is lighted from a gasolene tank located about 25 feet from the house and sunk about five feet below the surface of the lawn. The illuminating gas is obtained by forcing air into the tank from an air pump in the cellar, this air mixing in varying proportions with the gasolene vapor, and passing from the tank through the purifer to the gas jets. The proportion of air to gas vapor is regulated by cams designed for this purpose and attached to the air pump. Owing to the drawing off of the gas vapor, the 100 gallons of high grade gasolene which were put into the tank two years ago were about devolatilized, and the lights were getting dimmer every day, even with a mixture of 10 per cent. air and 90 per cent. gas vapor. Then the problem was to get the devolatilized gasolene out of the tank so it could be replaced with new and more volatile gasolene. It would have taken a day to pump it out by hand, and a plumber in that part of the country would probably charge $25 for the job.

Three pipes lead from the gasolene tank to the ground surface immediately above it; one of them is used for filling purposes and goes into the upper part of the tank; the second goes down to the bottom of the tank; the third contains the chain attached to the float that tells the level of the gasolene in the tank. This is what happened. The air pump on the Pierce was connected by hose and air valve to the pipe running from the ground to the top of the tank. The garden hose was connected to the car radiator, and the draw-off radiator cock opened. Empty barrels and buckets were placed close to the pipe leading from the bottom of the tank to the ground, and a short length of rubber hose was attached to this pipe. The driving gear was thrown out, the Pierce engine started, the air pump gear was thrown in, and the garden hose valve opened wide enough to give a fair flow of cold water through the radiator. The air gage showed a pressure of about 30 lb. After ten minutes of pumping, the gasolene could be seen rising in the tank, and five minutes later it gushed out of the main pipe at the rate of about three gallons a minute. The entire tank was emptied in about half an hour, the gasolene obtained being emptied into the tanks of Franklin and Pierce cars, and utilized by them, in turn, to cut the lawn and pump more gasolene out of the hourse lighting tank. The float valve chain in the third pipe showed when the tank was empty. The warm water from the radiator was used for washing the hands free from gasolene, rust, and dissolved rubber.

ATMOSPHERIC COOLING

The cooling power of the atmosphere depends upon other things than its temperature and the temperature of the body cooled. Thus, the wind is an important factor; as is the radiating power of the body in question. Dr. J. R. Milne, of Edinburgh, has described to the Scottish Meteorological Society an instrument for measuring the rate of cooling from a standard surface maintained at a fixed temperature of 98.4 deg. Fahr. This is "blood heat," and appears to have been chosen in order that the readings of the instrument may be a measure of analogous effects upon the human body. The device consists of a cylinder of thin copper, insulated except for its hemispherical top with plaster of paris. It is filled with paraffin oil, and the amount of electrical energy necessary to keep the oil at blood heat is continuously recorded. Hence may be deduced the loss of calories per square centimeter per second.

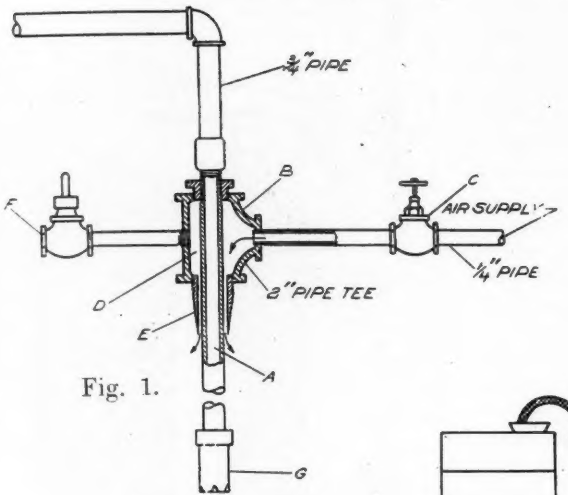


Fig. 1.

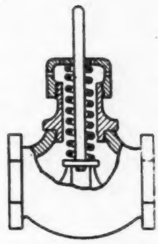


Fig. 2

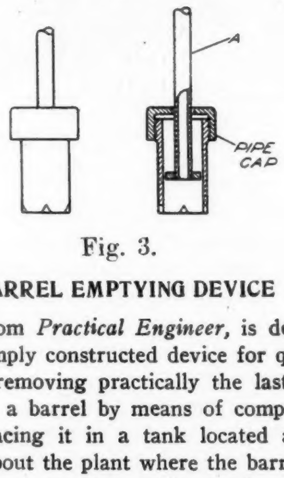


Fig. 3.

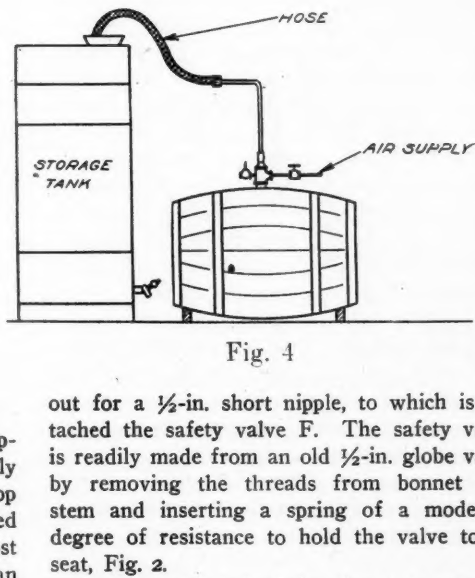


Fig. 4

A BARREL EMPTYING DEVICE

Fig. 1, from *Practical Engineer,* is descriptive of a simply constructed device for quickly and easily removing practically the last drop of oil from a barrel by means of compressed air, and placing it in a tank located almost any place about the plant where the barrel can be rolled or where a hose will extend.

The long nipple A reaching down into the barrel is threaded back at its upper end to pass through a reducing bushing in the upper end of the 2-in. pipe tee B. This forms an air or pressure chamber D independent of the interior of the pipe A. The lower end of the pipe tee B is fitted with a taper sleeve or nipple E, which is to fit the various sized bungholes of the different barrels with which the device may be used. The air supply from valve C is through a ¼-in. pipe, and passing out of the chamber D around the pipe A exerts its pressure over the top of the oil, forcing it up through the pipe A to the delivery end and into the storage tanks. The side opposite the air supply pipe connection is drilled and tapped out for a ½-in. short nipple, to which is attached the safety valve F. The safety valve is readily made from an old ½-in. globe valve by removing the threads from bonnet and stem and inserting a spring of a moderate degree of resistance to hold the valve to its seat, Fig. 2.

To the lower end of the pipe A is attached the sliding sleeve G to reach to the bottom of the barrel in case its diameter should be of a size to prevent the nipple A from getting near enough to empty the entire contents. The sleeve G is also constructed of pipe fittings in the manner shown by Fig. 3.

INSTALLING COMPOUND PNEUMATIC MINE LOCOMOTIVES

The Inspiration Consolidated Copper Co. has placed an order for six compressed-air locomotives with the H. K. Porter Co. A high-pressure Ingersoll-Rand compressor has also been purchased with sufficient capacity to serve 14 of the locomotives, which is the number it is expected eventually to employ. The

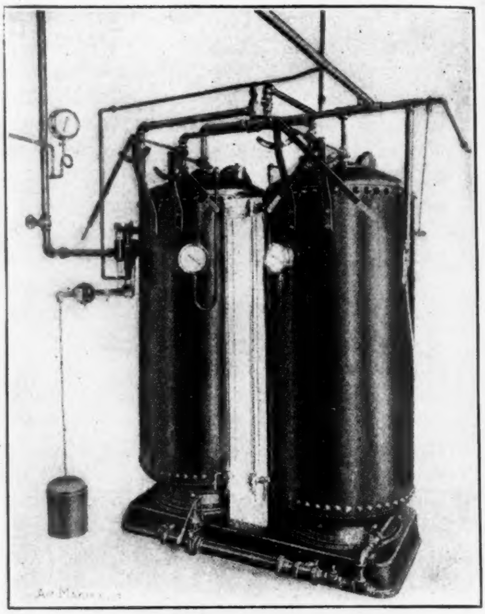
locomotives are 10-ton machines of the two-stage type. The main storage tank is charged with air at a pressure of 800 lb. from charging stations conveniently located about the mine and connected by pipe line with the compressors. The air in the pipe line is carried at 1000 lb. in order to provide a reserve supply available for charging the locomotives immediately and rapidly. It is estimated that with the design of charging station used, the locomotive will be able to come to rest, receive a charge of air, and be in motion again in 90 seconds.

The air from the engine reservoir is dropped by means of a reducing valve to 250 lb. before it enters the high-pressure cylinder. In this cylinder it expands from 250 lb. to 50 lb., and performs approximately one-half of its work. By this expansion the temperature is dropped to about 140° below that of the surrounding atmosphere, and to restore it approximately to atmospheric temperature before entering the low-pressure cylinder, it is passed through an interheater, which consists of an elongated cylinder filled with small tubes through which atmospheric air is drawn at high velocity by means of a draft induced by the low-pressure cylinder exhaust. The low-pressure cylinder has about four times the volume of the high-pressure and exhausts the air at atmospheric pressure. It is stated that numerous tests have demonstrated that this type of compressed-air locomotive under average conditions is 50% more efficient than the old-type single-expansion machine.—*Eng. and Min. Journal.*

WATER DISPLACEMENT AIR METER

The ordinary type of meter which consists of some form of motor arranged to register the volume of gas passing through it, on a dial, by means of a train of gears, was found to be unreliable for accurate work where large volumes and high pressures were used and close readings were wanted. For the purpose of accurately gaging such flow the Ingersoll-Rand Co. designed and put in use the meter shown in the accompanying illustrations.

Fig. 1 is a section through the meter. Figs. 2, 3 and 4 are diagrams of the meter, showing different arrangements of the valves. The meter consists of two tanks *A* and *B*, Fig. 1, of the same size mounted side by side on a base. The upper portions of these tanks are connected to the source of supply by the pipe



DISPLACEMENT AIR METER.

M, the opening into the tank *A* being controlled by the valve *H*, and into the tank *B* by the valve *G*. This is the inlet line. The outlet line is also connected to the top of the tanks by the pipe *N*, the opening into the tank *A* being controlled by the valve *K*, and to the tank *B* by the valve *J*.

The tanks are connected with each other at the bottom through the openings *C* and *F* by the pipe *D*. In this pipe line *D* is a valve *E* arranged to close communication between the tanks. This valve is of the quick-opening type and should be of the kind known as a gate valve, so that it will offer very little resistance to the flow when open. The tank *A* is provided with a gage glass *V* connected to the upper portion of the tank at *U*, and the lower portion at *W*. The tank *B* is provided with a similar gage-glass *S* connected with the upper portion of the tank at *R* and the lower portion at *T*. The tank *A* is provided with a pressure-gage *Q*, and tank *B* with a similar gage *P*.

The inlet line is provided with a pressure-reducing valve *L*. While this is not essential to the meter, it is a great convenience, as it prevents fluctuations in the pressure on the inlet line from affecting the reading of the meter, and, further, it allows the meter to be used on pressures lower than that of the source of supply.

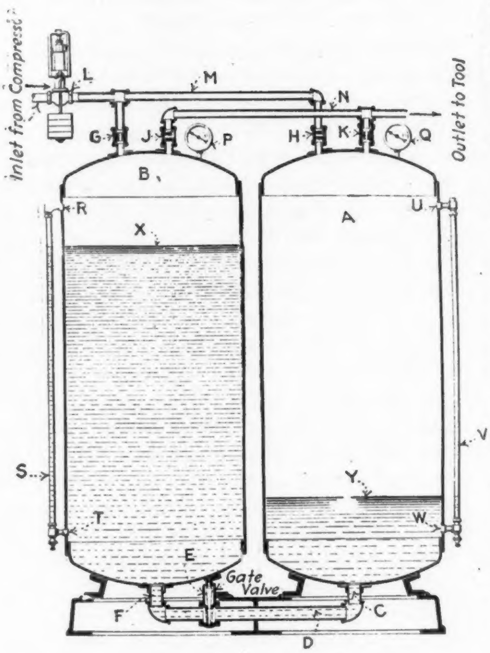
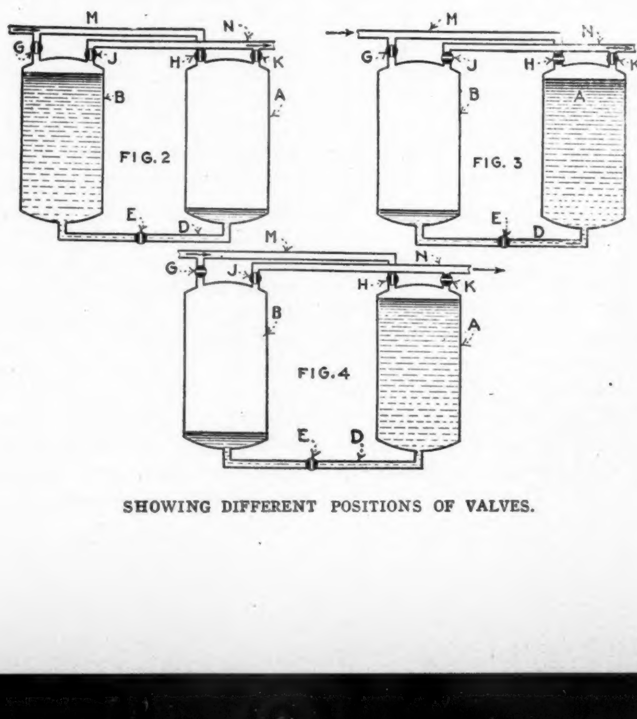


FIG. I. SECTION OF DISPLACEMENT METER.

The reducing-valve *L* is set for the desired pressure. The machine whose capacity is to be measured is connected to the outlet line. The valves are now set as shown in Fig. 2, the top portion of each tank being open to both the inlet and the outlet line. The valve *E* in the line *D* being closed, the water is held stationary in each tank. With the valves in this position, air from the inlet line will pass through the tanks directly to the outlet line and through the machine connected thereto. In this state the meter acts as a receiver for the storage of air and has no effect on the air passing through it.

To measure the volume of air passing through the machine, the throttle valve on the machine is first closed. As soon as the pressure in the tanks becomes equal, as indicated by the gages *P* and *Q*, the valves are changed to the position shown in Fig. 3. The tank *B* is now in communication with the inlet line but cut off from the outlet line. The tank *A* is opened to communication with the outlet line but closed to the inlet line. The level of the water in the gage-glass *S* is noted, and the valve *E* is opened. The valves are now in the position shown in Fig. 1, and the meter is ready to measure the volume of air passing through the machine.

When the throttle on the machine is opened, the air in the tank *A* passes through the outlet line to the machine. This causes a slight reduction in pressure in the tank *A*. The air in the tank *B* now causes the water to flow from the tank *B* to the tank *A* again, equalizing the pressure in both tanks, the pressure in the tank *B* being maintained by the air from the inlet line *N*. This flow of water causes a drop in the level of the water in the gage-glass *S*. At the end of the interval during which it is desired to measure the volume of air used, the valve *E* is quickly closed.



SHOWING DIFFERENT POSITIONS OF VALVES.

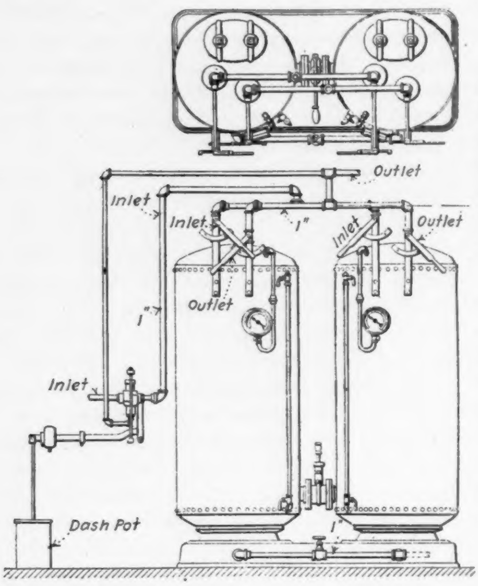


FIG. 5.

This prevents further flow of water. The drop of level in the gage-glass *S* is now measured, and from this the volume of air used is calculated, the volume of the tanks *A* and *B* having been previously determined.

When the level of the water rises to the top of the tank *A*, the valves in the inlet and outlet lines are thrown to the position shown in Fig. 4. The meter is now ready for further measurements after the pressure in the tanks has been equalized and the valve *E* opened as described. The conditions are now reversed and the water will flow from the tank *A* to the tank *B*, readings being taken on gage-glass *V*. In actual practice the valves on the meter can be manipulated with such rapidity that it is not necessary to stop the working of the machine to be tested, and any number of readings can be taken while the machine is in constant operation.

When using the meter, readings are taken by using a graduated board, which is placed behind the water-gage glasses, one graduation being used for each pressure. At the beginning of the test a rubber band is placed on each water-gage glass showing the height of the water, and at the conclusion of the test the drop may be easily measured on the graduated stick, thus giving the amount of air used.

THE NEW YORK COMPRESSED AIR WORKERS' LAW

The followng is a complete copy of the law, as radically amended by the New York Legislature, governing the conditions under which labor may be employed in compressed air. It is understood that the law as it now stands has the approval both of the contractors engaged in that class of work and of the Union of Compressed Air Workers.

Section 134-a. HOURS OF LABOR—All work in the prosecution of which tunnels, caissons or other apparatus or means in which compressed air is employed or used shall be conducted subject to the following restrictions and regulations: When the air pressure in any compartment, caisson, tunnel or place in which men are employed is greater than normal and shall not exceed 21 lb. per sq. in., no employee shall be permitted to work or remain therein more than eight hours in any 24 hours and shall only be permitted to work under such air pressure provided he shall, during said period, return to the open air for an interval of at least 30 consecutive min., which interval his employer shall provide for. When the air pressure in any compartment, caisson, tunnel or place in which men are employed is greater than normal and shall equal 22 lb. and does not exceed 30 lb. per sq. in., no employee shall be permitted to work or remain therein more than 6 hours, such four hours to be divided into two periods of three hours each with an interval of at least one hour between each such period. When the air pressure in any such compartment, caisson, tunnel or place shall exceed 30 lb. and shall not equal 35 lb. per sq. in., no employees shall be permitted to work or remain therein more than four hours, such four hours to be divided into two periods of two hours each, with an interval of at least two hours between each such period. When the air pressure in any such compartment, caisson, tunnel or place shall equal 35 lb. and shall not exceed 40 lb. per sq. in., no such employee shall be permitted to work or remain therein more than three hours in any 24 hours, such three hours to be divided into periods of not more than one and one-half hours each, with an interval of at least three hours between each such period; when the air pressure in any such compartment, caisson, tunnel or place shall equal 40 lb. and shall not equal 45 lb. per sq. in., no employee shall be permitted

to work or remain therein more than two hours in any 24 hours, such two hours to be divided into periods of not more than one hour each; with an interval of at least four hours between each such period; when the air pressure in any such compartment, caisson, tunnel or place shall equal 45 lb. per sq. in. and shall not exceed 50 lb. per sq. in., no employee shall be permitted to work or remain there more than 90 min. in any 24 hours and such 90 min. to be divided into periods of 45 min. each, with an interval of not less than five hours between each such period; no employee shall be permitted to work in any compartment, caisson, tunnel or place where the pressure shall exceed 50 lb. per sq. in., except in case of emergency. No person employed in work in compressed air shall be permitted by his employer or by the person in charge of said work to pass from the place in which the work is being done to atmosphere of normal pressure, without passing through an intermediate lock or stage of decompression, which said decompression shall be, where the work is being done in tunnels, at the rate of three pounds every two minutes unless the pressure shall be over 36 lb., in which event the decompression shall be at the rate of one pound per minute; and which said decompression shall be, where the work is being done in caissons, at the following rates:

Where pressure is not over 10 lb. per sq. in. the time of decompression shall be one minute;when pressure is over 10 lb., but does not exceed 15 lb., the time of decompression shall be two minutes; when pressure is over 15 lb., but does not exceed 20 lb., the time of the decompression shall be five minutes; when pressure is over 20 lb., but does not exceed 25 lb., the time of decompression shall be 10 min.; when pressure is over 25 lb., but does not exceed 30 lb., the time of decompression shall be 12 min.; when pressure is over 30 lb., but does not exceed 36 lb., the time of decompression shall be 15 min.; when pressure is over 36 lb., but does not exceed 40 lb., the time of decompression shall be 20 min.; when pressure is over 40 lb., but does not exceed 50 lb., the time of decompression shall be 25 min.

All necessary instruments shall be attached to all caissons and air locks showing the actual air pressure to which men employed therein are subjected, and which instruments shall be accessible to and in charge of a competent person who shall not be employed more than eight hours in any 24 hours.

Section 134-b. MEDICAL ATTENDANCE AND REGULATIONS—Any person or corporation carrying on any tunnel, caisson or other work in prosecution of which men are employed or permitted to work in compressed air, shall, while such men are so employed, also employ and keep in employment, one or more duly qualified persons to act as medical officer or officers who shall be in attendance at all necessary times while such work is in progress, and whose duty it shall be to administer and strictly enforce the following:

(a) No person shall be permitted to work in compressed air until after he shall have been examined by such medical officer and reported by such officer to the person in charge thereof as found to be qualified, physically, to engage in such work.

(b) In the event of absence from work, by an employee for 10 or more successive days for any cause, he shall not resume work until he shall have been re-examined by the medical officer and his physical condition reported, as hitherto provided, to be such as to permit him to work in compressed air.

(c) No person known to be addicted to the excessive use of intoxicants shall be permitted to work in compressed air.

(d) No person not having previously worked in compressed air shall be permitted during the first 24 hours of his employment to work for longer than one-half a day period as provided in Section 134a; and after so working shall be re-examined and not permitted to work in a place where the pressure is in excess of 15 lb. unless his physical condition be reported by the medical officer, as heretofore provided, to be such as to qualify him for such work.

(e) After a person has been employed continuously in compressed air for a period of three months he shall be re-examined by the medical officer and he shall not be allowed, permitted or compelled to work until such examination has been made and he has been reported, as heretofore provided, as physically qualified to engage in compressed-air work.

(f) The said medical officer shall at all times keep a complete and full record of examinations made by him, which record shall

contain dates on which examinations were made and a clear and full description of the person examined, his age and physical condition at the time examined, also the statement as to the time such person has been engaged in like employment.

(g) Properly heated, lighted and ventilated dressing rooms shall be provided for all employees in compressed air, which shall contain lockers and benches and shall be open and accessible to the men during the intermission between shifts. Such rooms shall be provided with baths, with hot- and cold-water service and a proper and sanitary toilet.

(h) A medical lock shall be established and maintained in connection with all work in compressed air when the maximum pressure exceeds 17 lb. as herein provided. Such lock shall be kept properly heated, lighted and ventilated and shall contain proper medical and surgical equipment. Such lock shall be in charge of a certified trained nurse selected by the medical officer, who shall be qualified to render temporary relief.

(i) Whenever in the prosecution of caisson work in which compressed air is employed, the working chamber is less than 10 ft. in length and when such caissons are at any time suspended, or hung, while work is in progress, so that the bottom of the excavation is more than nine feet below the deck of the working chamber, a shield shall be erected in the working chamber for the protecton of the workmen.

(j) Whenever in the prosecution of work in which compressed air is employed, a shaft is used, all such shafts shall be provided with a safe, proper and suitable ladder for its entire length.

(k) Whenever in the prosecution of work in tunnels, caissons or other apparatus or means in which compressed air is employed or used, lights other than electric lights are used, the said lights shall at all times be guarded.

(l) All passage ways in work, wherein compressed air is employed or used, shall be kept clear and properly lighted.

The Pennsylvania System has about 2872 steel passenger cars in service, which is one-half the total number of such cars in service in the United States.

FINDING THE DEW-POINT

A simple method of determining the dew-point in ordinary atmospheric conditions is described by Heggendorff in the *Physikalische Zeitschrift* as follows: Take a cup of thin metal, say silver or copper, fill it with water and introduce the bulb of a thermometer. Then add slowly some salt, such as sal ammoniac or hyposulphite of soda, the solution of which lowers the temperature of the mixture, meanwhile stirring the liquid with the thermometer. At the precise moment when the outside of the cup begins to show moisture note the temperature registered by the thermometer, and this will be the dew-point temperature of the surrounding air. The humidity percentage at normal temperature may be ascertained from this by the aid of the proper tables.

A COMPRESSOR SUGGESTED FOR SAFETY

The oil tank steamer Saranac, carrying 6300 tons of oil from New York to Calcutta, when seven miles from Point de Galle, Ceylon, and three miles from shore, struck an uncharted rock three times and it was found that two of the tanks in the middle of the ship were letting in water. The water lifted the oil to the top of the tank and there it stopped, and in this condition the ship was run up to Calcutta, a distance of 1000 miles and taking five days. The vessel went into dry dock and only then the extent of the damage was discovered. Fore and aft were two huge rents in the plates, many of which had been started, and in the middle of the hull was a gash 20 ft. long and 1 in. wide, while here and there were dents big enough for a man to put his head through. The top of the tank was evidently oil tight, or air tight, and a small compressor could soon have forced in air enough above the oil to drive the water out, leaving the ship as light and as high out of the water as before the accident.

July 4 this year marked the seventy-third anniversary of the initial sailing of the Cunard liner Britannic from the Mersey for Boston, establishing the first regular steamer service between England and America. This first trip of the Britannic occupied fourteen days and eight hours. The record of the Mauretania is less than one-third of this: four days, ten hours and forty-one minutes.

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AN OVERSIGHT IN THE COMPRESSED AIR LAW

BY FRANK RICHARDS.

Working in compressed air is an occupation which has its dangers, and the conditions under which such work is carried on come legitimately under the cognizance of the law. The regulations prescribed in the amended law of the State of New York must have general approval, as to their intent at least.

As to the precise conditions to be insisted upon for compressed-air workers, and especially the time and pressure limits in decompression, there must always be more or less room for discussion, with differences of opinion unreconciled after all. When records and experiences are appealed to they are found to vary much in their testimony and to be more or less contradictory.

This may result perhaps from the overlooking of two important conditions having to do with the health and safety of compressed-air workers, viz., the breathable condition of the air, as determined principally by the volume furnished, and also its temperature.

It may fairily be assumed that the condition of the worker as he enters the decompression chamber must have its effect all through the decompression in determining its success and the time necessary for its safe completion. From discrepancies in the results of decompression, where the pressures and times have corresponded in the different cases, it may be a simple matter to assume that the condition of subjects in the different cases as they have entered the decompression chamber (the conditions resulting from their hours of work under pressure and according to the character of the confined atmosphere, as to oxygen content, etc.) may not have been the same. If a man has worked his stent in the compressed air with the air as pure and as rich in oxygen as possible, and also reasonably cool, he may be expected to be, all through the decompression and at the end of it, in much better condition than one who has worked almost to the verge of complete collapse in hot air which has not been constantly and copiously renewed.

There is nothing about the use of compressed air in caissons and tunnels which provides for any automatic renewal of the air, or the taking care of the condition of it in any

way. The principal function of compressed air in the caisson is to prevent the water from forcing its way in under the lower edge of it, and, providing there were no leakage, the only compressed air functionally required would be for increasing the pressure as the caisson was sunk deeper. It is evident, however, that men could not live and work in air confined like that, and it therefore must be constantly renewed. It is only necessary to force in the air in sufficient quantity; the surplus will constantly escape under the lip of the caisson, and the pressure can never be increased above that required to resist the water pressure.

If sufficient compressor capacity is provided and kept operative it is all that can be required, but as this is an expense there is always some temptation to keep the supply of newly compressed air as low as possible, with the result that it may sometimes be deficient. This should not be permitted, and it would seem to be entirely within the scope of the law, when it undertakes to secure safe and proper working conditions, to insist that sufficient air shall be supplied and that the air within the working chamber shall be in as respirable condition as circumstances will permit. This would be to the interest of the contractor, however he might regard it, since it would enable the men to work with higher efficiency.

One objection to the use of the electric light in the caisson is that it gives no intimation of the condition of the air, as would a candle, and it might be very proper to require that at least one candle should be kept always burning in the caisson, and as long as its flame glowed bright and clear the men would have no occasion to worry about the respirable condition of the air.

There is, however, the temperature of the air to be considered. In caisson work, which for each individual caisson does not usually last long, it is customary to supply the air from a single-stage compressor located nearby. The law contemplates working in compressed air up to a limit of 50 lb. gage. When air with an intake temperature of 60° F. is compressed to only 20 lb. the final temperature is above 200° F., and with the intake temperature only a little higher the delivery temperature would be above that of boiling water. Some of this heat is undoubtedly lost in transmission, but the air must enter the caisson very hot, and it goes without saying that in every case an aftercooler should be required for the air, and that there should be a constant record of the temperature at which it enters the caisson, with a predetermined limit which should not be exceeded.

When compressed air is employed for the driving of subaqueous tunnels the condition of the air in the working chamber may be expected to be much better for the proper respiration of the workers than in the caisson. The air compressed is generally transmitted such a distance that the heat of compression disappears, so that little attention need be given to the working temperature, and then the air is constantly escaping, so that its renewal is a necessity for the approximate maintenance of the working pressure. At the tunnel face there is no balance of pressures as in the caisson. It must always be that in order to maintain sufficient pressure to hold back the water near the bottom of the tunnel there must be a considerable excess of pressure at the top of the tunnel and the air is bound to escape, demanding constant replacement.

When the tunnels were being driven under the East River for the Pennsylvania R. R., those who crossed the river by the 34th St. ferry had no need to be told how copious was the escape of the air, as the boiling of the water spoke for itself.

It is not difficult for us to believe that the excellent record of the East River tunnels as to caisson disease among its workers may be attributed, not only to the strict and careful decompression practice, but also to the excellent condition of the workers before submitting themselves to the decompression.

It will be noticed that the new law having to do with compressed-air practice deals almost entirely with the regulations for decompression, and this it does so thoroughly that the workers who submitted themselves to the decompression in strict accordance and in full compliance with the rules prescribed might be smothered in the chamber and taken out dead. Gradual decompression, which is the only thing insisted upon by the law, could be accomplished by merely shutting the men into the chamber under the full pressure and then slowly letting off the pressure according to schedule.

In the decompression, if nowhere else, the

men should have pure air and lots of it, the air should be at a uniform temperature and the temperature should be that determined to be most suitable. Both these conditions are more or less imperative and are not difficult, although costing something, to provide, but the law says nothing about them.—*Engineering News.*

AIR CONDITIONING FOR TEXTILE MILLS

BY FREDERICK W. PARKS.

Artificial humidification is no longer a theory. For years it was on trial, as it were, in textile manufacturing, but rapid progress has been made in the last few years. Knowledge of the subject is becoming general, the needs for textile working conditions are better understood, and the practice is becoming more standardized. Humidifiers are no longer considered a luxury and their adoption a whim, and few mills are now built without at least considering the need of humidifiers. Few cotton mills, indeed, are now built without installing humidifiers at the start.

There are so many types of apparatus on the market that the engineer or mill owner should have no trouble in selectng the one best suited to the needs of the case. Some are designed especially for new mills, others for either old or new plants, some for small isolated units, and so on. Like the Kentuckian's whiskey, all are good, but some are better than others.

A circular letter upon this topic was written to textile plants throughout the country, and 81 mills replied. As evidence of the value of humidification, an analysis of reports from these mills is highly interestng. The points on which these mills reported were as follows: The influence of humidifiers on production, floor sweeps, invisible waste, second quality goods, static electricity, broken ends in spinning, loom shut down, strength of product, mill temperature, health of operatives and estimated return on investment.

It is an interesting fact that not one unfavorable reply or discordant vote of any sort was received. Many would not report at all on some points for lack of data, as for instance a new mill which had never been without humidifiers.

The experience of one mill (a Northern cotton yarn mill about three years ago and humidified when built) is interesting enough to quote here: "Our invisible waste for 1911 was 1¾%, which is very low. Our production was 93%. Our regain from cotton to yarn averaged 6% on 2,000,000 pounds of cotton per year. Our humidifier cost $10,000."

These reports were not obtained for the purpose of exploiting any particular make of humidifier, for these 81 mills had 11 different types in use. Among these 57 mills were silk, rami, worsted and cotton mills, although cotton mills predominated. In number they were equally divided between the North and South, so the reports may be considered as fairly representative of the textile industry.

So far, I have been giving you the evidence to prove the need of humidifiers. In building a new mill, admitting humidification to be necessary, the next step is the selection of the proper type of apparatus. Some sort of system can be purchased at almost any price you wish to pay. There is one point, however, that is interesting enough to bring out right here. Be sure to purchase capacity enough. Higher humidities are being demanded right along. The man that asked for 65% in cotton weaving five years ago is now demanding 75% and wishing he could get 80%.

Theoretically, and I emphasize that word theoretically, humidification is only one of three treatments that the mill air needs. The other two treatments are ventilating and heating, and these three functions combined may probably be called conditioning.

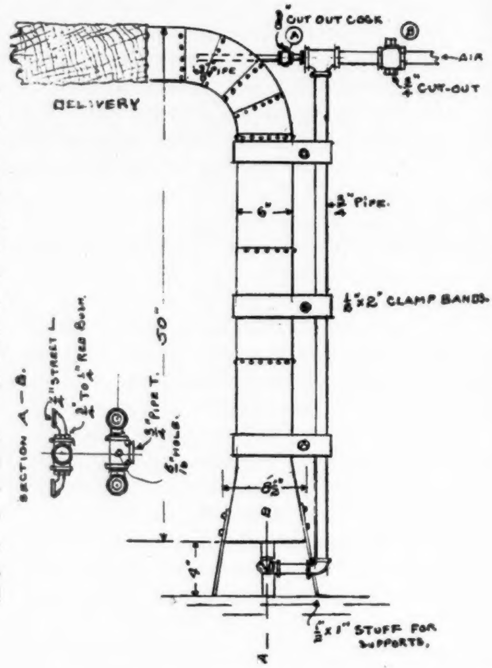
There is no close relationship between these three variables, for each must be capable of adjustment or operation at any load at times entirely independently of the other two, or in any possible combination with the other two.

Take, for instance, a zero morning in winter. We may run our heating system at peak from midnight till starting time. At five o'clock, the metal being then warm and there being no danger of precipitation and rusting, we may start our humidifiers so as to have a proper amount of humidity when the power starts. With the starting of the power and the coming to work of the employees we start our ventilation at peak and maintain it so all day. This air change may call for more humidity. By eight o'clock the heat of the machinery and the improved circulation of air due to revolving shafting and belting have increased the temperature so that we shut off part of the heat. By nine o'clock we may shut

off more heat if the sun is bright and there is no wind, yet our humidifiers and ventilation may not have been disturbed.

In this condition we may run until noon, when we shut off our ventilation during the noon hour because the occupants have left. We may or may not shut off our humidifiers, depending on atmospheric conditions. At sunset more heat is needed, but the demand is not as great as in the early morning because we have a mill full of warm machinery. At closing time we stop the ventilation, humidity, and heat, and repeat the process the following day. Take any working day in the year and it will call for a similar variation of these three widely varying functions.

A textile mill is not a physical laboratory, and cannot be made one. The average mill is intent on manufacturing, and cannot be expected to care for complicated delicate apparatus not a part of a manufacturing process. Our heating, humidifying and ventilating, therefore, must be as simple and as near fool proof as possible.



COMPRESSED AIR FOR TRANSFERRING GRAIN

When grain is being transported in bulk by railroad it often happens that a car containing it is disabled by accident or otherwise so that it becomes necessary to transfer the grain, and the sketch here reproduced from *Railway and Locomotive Engineering* shows an arrangement which has been employed for the purpose, using compressed air as the active agent.

The body of the apparatus as shown is a 6 in. pipe of 1-16 in. sheet iron supported by three legs, more or less, the size and number of which can be varied to suit different conditions. The pipe is enlarged at its lower end and the legs support it about 4 in. from the car floor. The compressed air pipe running down outside extends in under with a horizontal tee located at the center of the pipe, and at each end of the tee is a "street" L looking upward. As the loose grain occupies all the space at the bottom of the pipe, when the air is turned on by valve B in the air supply at the top, the blasts from the elbows send the grain up the pipe, and then valve A supplies additional air to the horizontal pipe which sends the flow along to be delivered into another car or elsewhere.

The time for emptying a car of course depends on the nature of the grain, but the dimensions indicated in the sketch were found to be well adapted for all light grains. Supplied with an unbroken flow of air at 90 to 100 lb. the device will do as much work as five or six men.

PRINCIPLES AND ADVANTAGES OF MECHANICAL REFRIGERATION

There are some lines of business in which it is evident that the installation of a refrigerating plant will give better results, as, for instance, installations requiring the refrigeration of showcases and windows, those requiring the maintenance of very low temperatures, and those in which different degrees of temperature are required for different classes of service.

Some of the advantages of mechanical refrigeration are as follows:

(1) Lower temperatures obtained with refrigerating machines than with ice.

(2) Absence of the dirt and muss often accompanying the use of ice.

(3) No accumulation of slime in the refrigerator.

(4) Refrigerators cooled mechanically are

dryer than ice-cooled boxes because the moisture in the air deposits on the cooling pipes and is frozen.

(5) Any desired temperature can be obtained and maintained.

(6) Show-windows and show cases refrigerated mechanically at any desired temperature, thus permitting an attractive display of perishable goods.

In general it may be said that almost all methods of obtaining refrigeration are based upon the fact that when a liquid evaporates or turns from a liquid into a gas or vapor, it absorbs heat from its surroundings. There are a number of liquids which are easily made to evaporate and produce this cooling effect, and but for their cost, refrigeration could be very simply produced by supplying a steady stream of the liquid and allowing the vapor or gas evaporated to escape into the atmosphere. A refrigerating machine is practically an apparatus for saving this gas which has evaporated, and returning it to its liquid form to be used over again.

In this process of recovery and condensation the gas gives out the heat which it has previously absorbed in evaporating. This heat is carried away by flowing water which absorbs it. The operation of a refrigerating machine thus causes a continuous cycle of evaporation, recovery and condensation. There are two general systems in use for producing refrigerating effects, the compression and the absorption.

In the compression system the recovery of the gas is effected by drawing it away from the point where it has been evaporated and pumping it under increased pressure into a chamber where it gives out its heat to the water-cooled walls of the chamber and returns to the liquid state ready to be used over again. A number of liquids have been used in compression refrigerating machines, those common being ammonia, carbon dioxide and sulphur dioxide.

In the absorption system ammonia is generally used and the recovery of the gas is effected by bringing it in contact with water with which it unites chemically. The solution thus formed is pumped into another chamber where the ammonia gas is driven off again by heating the mixture, and is then condensed under high pressure.

In the absorption system the liquid ammonia as it is released by the expansion valve passes into the low-pressure portion of the apparatus, the expansion piping, which is located at the point where the cooling is to be done. While expanding, the ammonia absorbs heat as it passes, and is carried to the absorber. This is a vessel of cold water. The strong affinity of ammonia gas for water causes a ready combination, and a constant sucking is produced tending to reduce the pressure in this section of the apparatus, thus permitting the expansion of the ammonia gas.

After being absorbed, the weak ammonia is pumped into another compartment called the generator, where the ammonia gas is driven out of the water by heat. The hot ammonia gas is then passed through a condenser to be liquefied. The condenser is a series of pipes arranged in vertical rows and cooled by flowing cold water. The liquefied ammonia is collected in the ammonia receiver to be again used through the same cycle of operation. The hot liquor (water) from which the ammonia has been boiled is pumped out, cooled and again used in the absorber.

AIR HAMMER DRILLS

In a recent comprehensive article in *Mining and Engineering World* entitled Recent Advances in Butte Mining Practice, by Claude T. Rice, the following occurs:

I mention air-hammer drills. In 1907 I doubt if there was a single drill of that type in use in the district except for plugging in the shafts. Now they are used in all the mines for stoping and raising, and in some of the mines there is not a pound of stope ore that is not broken with holes put in by air-hammer drills. Quite recently there has been considerable experimenting with the Ingersoll-Rand Jack-hamer type of hand drill, which seems to have met with such great success in drilling the foot-wall ore in the amygdaloid mines of the copper country. Also at Butte several of the mine foremen are looking favorbly on them, especially for drifting.

A railroad cut through coal on the new construction work of the Louisville & Nashville R. R. in the northern part of Alabama has been converted into a profitable mine by the contractor, who is selling the coal to his neighbor contractors.

(*Continued from Page 6986.*)

pleted to the floor above in the process of construction, with the added advantage that the planks are delivered at the exact point where they are needed. Pneumatic hoists are even more convenient for many hoisting operations.

In the modern weave room, the looms are driven from underneath, through the floor. This calls for a large number of belt holes, all of which are roughed out with augers. For this, a pneumatic boring tool may be mounted on ways hinged to a flat base. The hinge is adjusted and set at the desired angle. By standing on the base, the auger may be fed and withdrawn very conveniently. With the pneumatic tool, and two men, three times as many belt-holes are roughed out as by the old hand method.

Maple logs are often used for squeeze rolls in bleacheries and dye houses. Holes must be bored through them for the shafts. Mr. Thompson, referred to above as a pioneer in the use of compressed air in cotton making, described a satisfactory method of applying a pneumatic tool for boring these holes. He says "for this purpose the auger shaft is back-geared to a powerful pneumatic driller, both being attached to a special carriage on an old lathe bed. The log is carried on horses at the end of the bed, and the auger fed through by hand. To drive a four-inch "pod auger" through a 10-foot log used to be a day's task for two men, the heart-breaking part of the task being due to the necessity for the frequent pulling out of the auger to clear the hole of chips. With the modern apparatus four 10-foot logs are easily bored by one man, who requires no help except in the handling of the logs themselves to and from the machine."

MISCELLANEOUS USES OF COMPRESSED AIR.

There are doubtless many other applications of compressed air in cotton mills, which the writer has not encountered, and the possibilities of the further application of pneumatic power to cotton manufacturing processes are many. The application of compressed air in the making of velour hats, to raise the nap on the hat, was recently brought to our attention. It is probable that compressed air could be similarly applied with profit in making certain kinds of cotton goods having a nappy surface.

One cotton works which the writer visited used air pressure in a novel manner. Compressed air was piped to a tank to keep water under pressure for the operation of a heavy hydraulic freight elevator.

Several mills use air to blow the dirt and soot from the tubes of fire-tube boilers and they find that it is decidedly more satisfactory than steam for the same purpose. Boiler scale removing machines are also frequently operated by compressed air.

White walls contribute to the comfort and happiness of the operatives as well as cutting down the bills for artificial illumination. Paint or whitewash spraying machines, operating with compressed air are very efficient and convenient for this purpose, especially where they can be connected to the compressed air line, running through the mill.

Hundreds of mills are using compressed air for various purposes and we trust that this article, incomplete as it is, may be of some assistance to them and to those contemplating the use of compressed air.

NOTES

A model illustrating a new system of storing petrol (gasolene) in bulk is shown by the Hydraulic Petrol Storage Company, 11 Bothwell Street, Glasgow. The novelty of the system consists in the fact that the storage tank is always full of liquid, and that no air is admitted at any time. The liquid in the tank may be all petrol, or petrol and water, or all water. The water and petrol do not mix, and owing to the difference in their specific gravities the petrol always floats on the surface of the water. By simple, ingenious mechanism water is pumped into the tank to force out the petrol.

It is estimated that the daily production of oxygen in the United States is approximately 600,000 cu. ft. Of this quantity approximately one-half is supplied by 12 central stations situated in different parts of the country while the other half is produced by plants in individual works.

Plants require air in contact with their roots. If the soil water rises above 60 per cent of the saturation, the air is so reduced

that root development is seriously retarded. A large root system enables the crop to vigorously gather the plant food materials. Reduce root growth by having too much water in the soil and the crop is reduced accordingly, because it only has small feeding area.

A new building material, known as Tekton, which is being introduced by Ollendorff & Clarkson, Ltd., Glasgow, is stated by the London Times to be of the nature of artificial wood and to possess the strength and durability of concrete. The ingredients are magnesite, granulated slag, chloride of magnesium, and "wood flour," and its principal properties are that it is porous, has a low heat conductivity, and is sound-proof, fire resisting, odorless, and not liable to develop dry rot.

In order to facilitate the driving of the 22x 30 ft. double-track Canadian-Pacific Railway tunnel of 5 miles long, through the Selkirks, Foley, Welch & Stewart, the contractors, have decided to adopt a new method, according to the *Canadian Engineer*. This method consists of first boring a parallel tunnel 7 by 8 ft., for virtually the same length. From this tunnel cross-cuts will be made at short intervals to the site of the proposed large tunnel. This will enable gangs of men and machine drills to attack the work simultaneously at scores of points. Incidentally, the "pioneer" tunnel, as it is called, will also provide ventilation, and will, for a considerable time, provide an exit in removing the rock material.

Joseph Mango, of St. Clair, was overcome with gas at Wadesville colliery, Aug. 27, and had been given up as dead, but members of the first-aid corps, after working for an hour, revived him. Mango was removed to his home very ill, but he will recover. Although his body was cold and stiff, and his pulse had apparently ceased, the rescuers, George Phulright, Joseph Cook and William Webb, wrapped him in a blanket and forced oxygen into his lungs with a pulmotor.

In population Pittsburgh ranks fifth among the cities of the United States, having as "Greater Pittsburgh" only about one-sixth that of Greater New York, but in the consumption of coal alone Pittsburgh nearly equals that of the largest city in the country. It is estimated (no accurate data being available) that Greater New York consumes between 18,000,000 and 20,000,000 short tons of coal annually. The Pittsburgh district in 1912, according to Edward W. Parker, of the U. S. Geological Survey, consumed 17,721,783 tons of coal and about 5,000,000 tons of coke, or a total of about 22,700,000 short tons, over 10 per cent. more than all the boroughs of Greater New York. Pittsburgh also consumes millions of cubic feet of natural gas.

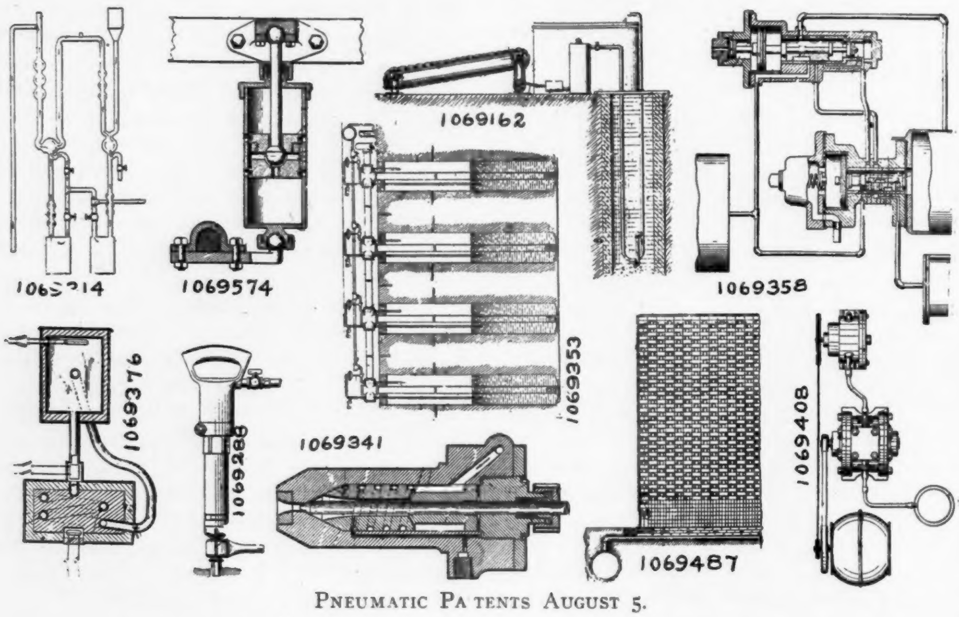
The vacuum-cleaner principle is having new applications every day; but one of the strangest is for the unloading of coal cars. It is stated that a big Austrian power plant is being equipped to handle all its coal by vacuum pipes. Coal that is graded according to Austrian standards as dust coal and nut coal is delivered in carload lots to the plant, and a great pipe is dropped into the car. The coal is sucked up through this pipe and carried to the storage bin.

There are 1,100,000 automobiles in America, or one for every two miles of country road. If all the steam locomotives (passenger and freight) were placed at equal intervals in the railway lines there would be one locomotive for every fourth mile. There are about as many passenger cars as there are locomotives, and 20 times as many freight cars as passenger cars; but all the freight cars, passenger cars and locomotives combined total only twice the present number of automobiles, and probably did not cost more than as much as all the automobiles.

A sudden and fierce fire, causing the loss of three lives, broke out in the building at the head of shaft No. 9 of the Catskill Aqueduct work in Manhattan, with 62 men working in the tunnel 450 feet below. The fire stopped the ventilating motor which supplied fresh air and the men were held in the dark, airless depths for five hours. Fire Chief Kenlon, in one of the most dangerous and spectacular rescues in the history of the department, led the firemen down long ladders while burning debris rained down about them. The perilous descent took 40 minutes and the men were found huddled back 1000 feet from the shaft and only able to stand the bad air for a little while longer.

A process whereby steel is hardened by means of compressed air is now in use by a German firm in cases where only certain parts of the metal require hardening. The customary methods of hardening by chilling the steel in water, oil, or special baths is not satisfactory in such cases, owing to the tension created between the hardened and unhardened portions of the treated metal. In the new procedure the compressed air is sprayed over the metal through specially designed nozzles, by means of which, by varying the number and spacing of the openings, the degree of hardening may be accurately graded.

Recent experiments have shown that the ordinary internal combustion motor as it stands to-day will consume alcohol slightly modified by other home-produced liquids with a very small loss in power as compared with gasolene, the loss being so small that there is practically no doubt that, if the compression were increased, it would be negligible if not entirely abolished. The common idea that a very special engine and a still more special carburetter are indispensable for using alcohol is not in accordance with facts. Alcohol with quite a small portion of benzene has proved to be a very satisfactory fuel.



PNEUMATIC PATENTS AUGUST 5.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

AUGUST 5.

1,069,162. CATTLE-PUMP. OTIS R. NICKERSON, Drexel, Mo.
1,069,214. SEPARATOR. JOHN N. WINGETT, Denver, Colo.
1,069,288. FLUID-FEEDING ATTACHMENT FOR HOLLOW DRILL-STEELS. WILLIAM PRELLWITZ, Easton, Pa.
1,069,289. FLUID - PRESSURE - OPERATED TOOL. WILLIAM PRELLWITZ, Easton, Pa.
1,069,341. PULVERIZER FOR OIL-ENGINES. HERMANN LEMP, Erie, Pa.
1,069,353. APPARATUS FOR PUMPING. SILAS W. TITUS, New York, N. Y.

1. The combination with a subterranean source of liquid supply and a sealed well extending into the same, of a suction pipe extending into said well, means for maintaining air under sufficient pressure within said well to raise the liquid level to a predetermined height within said suction pipe, an air relief pipe extending into said well and into the liquid therein to a given point below the level of said liquid, and means for controlling the discharge of excess air pressure when the liquid within said well falls therein and unseals the end of said air relief pipe, substantially as specified.

1,069,358. FLUID-PRESSURE BRAKE. WALTER V. TURNER, Edgewood, Pa.
1,069,376. COOKING APPARATUS. GEORGE GILBERT BELL, Kensington, London, England.

1. The combination of an oven, an air heater for supplying heated air thereto provided with a heat storage mass having a passageway for the air therethrough deflected at numerous places, whereby the air will be retarded in its passage through the air heater and will be brought frequently into contact with the heated surfaces of the heat storage mass.

1,069,408. METHOD AND APPARATUS FOR PRODUCING HIGH VACUUMS. WOLFGANG GAEDE, Freiburg, Breisgau, Germany.

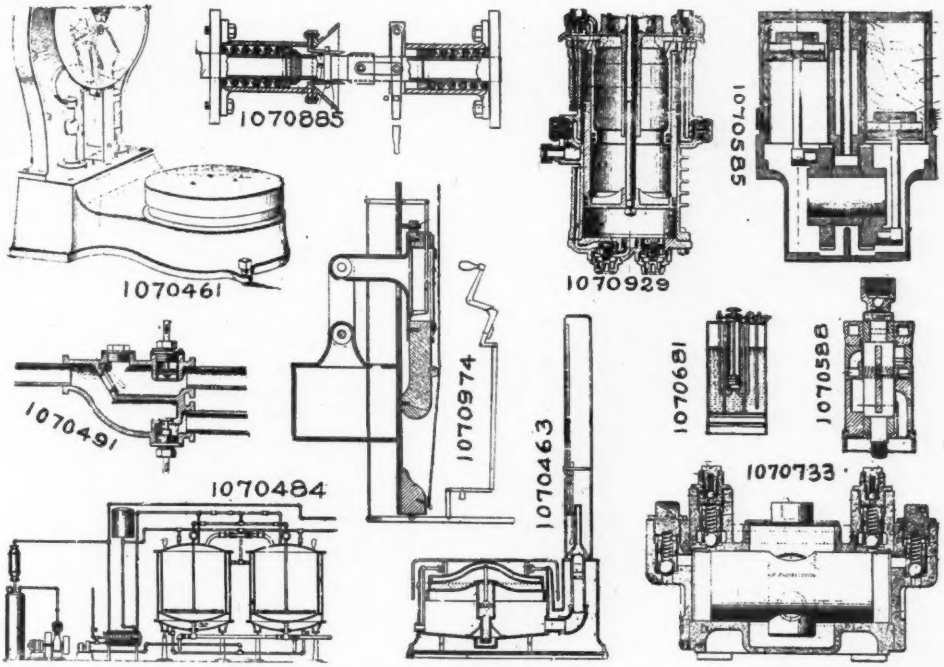
1,069,487. BRICK-KILN. JAMES R. SMITH, Mechanicsville, N. Y.
1,069,510. VACUUM-PUMP. JOSEPH ZEITLIN, South Kensington, London, England.
1,069,574. PNEUMATIC SHOCK-ABSORBER. LOUIS S. PACE and JOSEPH F. OSBORNE, Ironaton, Ala.

AUGUST 12.

1,070,134-5. MILKING-MACHINE. JOHN L. HULBERT, Poughkeepsie, N. Y.

1. In a milking machine, in combination, a teat cup, a passage for the milk constantly under and in communication with a source of suction, said passage leading from the milk discharge portion of the teat, means to intermittently compress the teat, and means to intermittently admit pressure fluid into said milk passage, between the teat discharge and the source of suction, alternately with the compression of the teat.

1,070,585. AIR-PUMP. CHARLES P. CLARKE, Boston, Mass.
1,070,588. ROTARY FLUID-PRESSURE MOTOR. PHILIP J. DARLINGTON, Plainville, Conn.
1,070,681. APPLIANCE FOR CHARGING DISINFECTING APPARATUS. JULIAN G. GOODHUE, Chicago, Ill.
1,070,733. AIR-COMPRESSOR. WILLIAM REAVELL, Ipswich, England.
1,070,740. APPARATUS FOR THE PNEUMATIC CONTROL OF MILKING-PULSATORS. THOMAS THOMASSEN SABROE, Copenhagen, Denmark.
1,070,885. AIR-BRAKE-TUBE CONNECTION. PASQUALE GENTILE, Niles, and ANGELO DEL GIUDICE, Youngstown, Ohio.
1,070,962. AIR-HOSE COUPLING FOR RAILWAY CARS. FRANK H. LONG, Winnemucca, Nev.
1,070,929. AIR-COMPRESSOR. LOUIS G. STONE, London, England.



PNEUMATIC PATENTS AUGUST 19.

AUGUST 19.

1,070,460-1. PNEUMATIC SCALE. STEPHEN E. HARBACK, Fort Smith, Ark.
1,070,484. PASTEURIZER. GEORGE M. KENDALL, New York, N. Y.

1. In a pasteurizing apparatus, the combination with a liquid container having a jacket adapted to receive a temperature controlling medium, a source of such medium and connections between the latter and the jacket, of a pneumatic agitator within the container adapted to discharge streams of air through the liquid contents adjacent to the jacketed walls, *a source of compressed air supply*, connections between the latter and the agitator, and means for subjecting the air to the same temperature controlling medium that is introduced into the jacket prior to its arrival at the agitator.

1,070,491. SYSTEM FOR STORING FLUIDS UNDER PRESSURE. WILLIAM B. LAKEY and GRAY STAUNTON, Muskegon, Mich.

1,070,974. COMBINED WIND AND STRINGED INSTRUMENT. MAX H. MATTES, New York, N. Y.

1. In a combined wind and stringed instrument, the combination of a string, means to cause the string to vibrate to produce a tone, pneumatically operated mechanism acting upon said string to modify its vibration and its tone, said mechanism including an air chest, a member comprising a reed cell, a reed connected to said member and located in close spaced engageable relation to the string, a tubular connection between the air chest and the reed cell, and means to control the passage of air through the reed cell, means to adjust said reed cell member toward or from the string so as to vary the effect of the reed upon the string, the air-chest remaining in fixed position, and means to simultaneously cause the operation of the string vibrating means and the means to control the passage of air through the reed cell.

AUGUST 26.

1,071,020. COMPRESSING AND LIQUID-EXTRACTING MACHINE. ELLIS BARTHOLOMEW, Toledo, Ohio.

1,071,059. GAS-ENGINE STARTER. STEPHEN S. KRAYER, St. Louis, Mo.

4. In a device of the character described, a number of radial chambers arranged to receive air under pressure, and a number of radial containers arranged adjacent to said chambers said chambers being arranged to receive a supply of liquid, air inlet passages to said air chambers, passages between each air chamber and a liquid container gas outlet passages from said liquid containers, liquid inlet and outlet passages from said liquid containers, and a valve operable to control said passages, substantially as specified.

1,071,164. APPARATUS FOR THE MANUFACTURE OF BREAD. GEORGE LUNT, Formby, England.

2. An improved apparatus for the treatment of dough comprising in combination an elastic fluid pump, reciprocating elastic fluid supply means, elastic fluid supply controlling means, an element operating said elastic fluid supply controlling means and a traveling dough support, as set forth.

1,071,199. MINERAL - PROSPECTING APPARATUS. BENJAMIN ANDREWS, Houston, Tex.

1. In an apparatus of the kind described, the combination with a bit, of a double drill stem connected therewith formed of two concentric pipes, and means for forcing air down through the outer and into the inner pipe, the inner pipe having its open lower end disposed to receive the material removed by the bit, substantially as described.

1,071,221. APPARATUS FOR TREATING OILS WITH GASES. CARLETON ELLIS, Montclair, N. J.

1,071,263. PNEUMATIC HAMMER. GEORGE L. ROBERTSON, Philadelphia, Pa.

1,071,381. LIQUID-FUEL BURNER. ALFRED R. ANTHONY, Montrose, Pa.

1,071,387. PERCUSSIVE APPARATUS. HANS CHARLES BEHR, Johannesburg, Transvaal.

1. In a percussive apparatus, the process of delivering an uncushioned blow, which consists in supplying on one side of a piston having an accelerated velocity a fluid pressure which does not substantially increase during the percussive stroke; supplying a varying second fluid pressure, adapted to fall to a predetermined point, on the other side of said piston; partially preventing said second pressure from varying while being supplied to said piston; and supplying additional fluid from an external source directly on said other side of said piston to prevent the said varying pressure from falling below said point, substantially as described.

1,071,446. FLUID-PRESSURE DEVICE. RICHARD LIEBAU, Watervliet, N. Y.

1. A cushion device, comprising relatively movable members forming a closed chamber, in combination with an internal compression pump having a compression chamber carried by one of said movable members, and a piston having its strokes coincident with the extension movements of said relatively movable members.

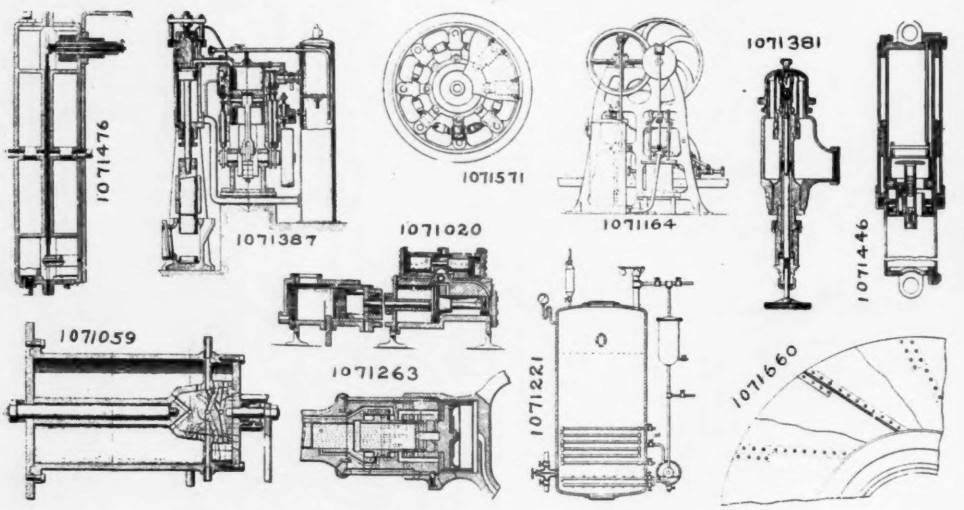
1,071,476. OZONIZER. EDWARD CHARLES SPURGE, Niagara Falls, N. Y.; Louise T. Spurge, George Emerson Cox, and George Slate, Jr., administrators of said Edward Charles Spurge, deceased.

1,071,571. PNEUMATIC WHEEL FOR VEHICLES. THOMAS PENDELL, Poughkeepsie, N. Y.

1,071,632. PROCESS OF TREATING MELTED METALS, ALLOYS, AND STEELS. LOUIS MARIE VICTOR HIPPOLYTE BARADUC-MULLER, Paris, France.

1. A process of removing gases from molten steel and the like, within a vacuum chamber, comprising evacuating the air and gases from said chamber, and subjecting the air and gases evacuated from said chamber to a rapid refrigeration to a degree below 0 degree C. before reaching the evacuating apparatuses, whereby the volume and temperature of the air and gases coming from the vacuum chamber are greatly reduced and a high vacuum produced in the vacuum chamber.

1,071,660. BLADING CONSTRUCTION FOR TURBO-COMPRESSOR IMPELLERS. OTTO BANNER, Easton, Pa.



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